GHT BOMBERS vs. ANTIAIRCRAFT

BY A ROYAL AIR FORCE WING COMMANDER

FLYING

including INDUSTRIAL AVIATION

DECEMBER RY
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WANTED: SOME CLEAR THINKERS

By CHARLES I. STANTON, Administrator of the CAA

NEXT STOP: TOKYO ★ FLYING AT 50,000 FEET

Captain Carder N. McNay, Braniff Airways pilot, predicts a new, peacetime prosperity that will follow America's wartime aviation progress.

"They're Building *Jobs* As Well As *Planes* in Wichi

to be ready when you boys come flying ho

"BELIEVE me, you fellows in the service have something to look forward to the day that Hitler hollers 'Uncle,'" says Captain McNay. "The airplane that *everyone can buy and fly* is ready now at Cessna to be produced as soon as this war is over. It's the Cessna Family Car of the Air. And Mr. and Mrs. America will be flying it all over America as naturally as they've driven automobiles for years.

"That's not just prop-wash. It's bound to And with it will come thousands of new jobs ing, selling and servicing thousands of Fami of the Air. What's more, there'll be miles of controlled airways, thousands of airports, strips and service stations to be operated. A means jobs, good jobs and lots of them, for t when they come marching, rolling, flying

Mrs. America Wins Her Wings

ember, Mrs. America likes to go and see things. And when she finds hat she can cover 600 miles in a ing, to shop or visit in any one of a cities, she's *going to fly.* And nothing op her.

, she'll be flying, taking off and landing, as easily as she drives her car, in a few hours after she first steps in a plane. Compared to the hundreds of American women flying today, hundreds of *thousands* will fly in the post-war tomorrow. Why? Because it's going to be *as easy as that* for you to fly the Family Car of the Air.

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Dwane Wallace
Presid

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Parks *college education majoring in aviation* prepares you to serve your country best in both military and commercial aviation — and qualifies you for a successful career in one of the world's greatest industries.

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Is accredited in its Aeronautical Engineering School by the Illinois Superintendent of Public Instruction.

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FLYING

VOLUME XXXI — *including* INDUSTRIAL AVIATION — NUMBER 6

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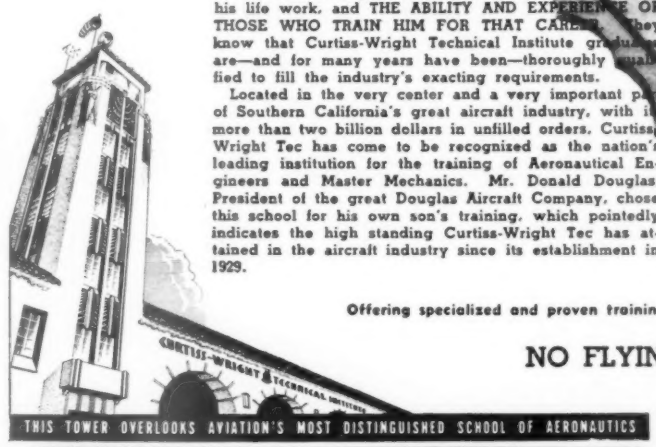
WAR PRODUCTION
U. S. AIR FORCES
FUTURE of AVIATION



THIS TOWER OVERLOOKS AVIATION'S MOST DISTINGUISHED SCHOOL OF AERONAUTICS

Never has it been more difficult to plan your future, but the one great lesson taught us by the war is that thorough technical training is the key to success. Whether you seek an important supervisory position in aircraft production or a high technician rating in the U. S. Air Forces, you can only obtain it through long-range training that prepares you for the more responsible positions . . . and ONLY such training can fit you for a career in the tremendous expansion of civil aviation after the war.

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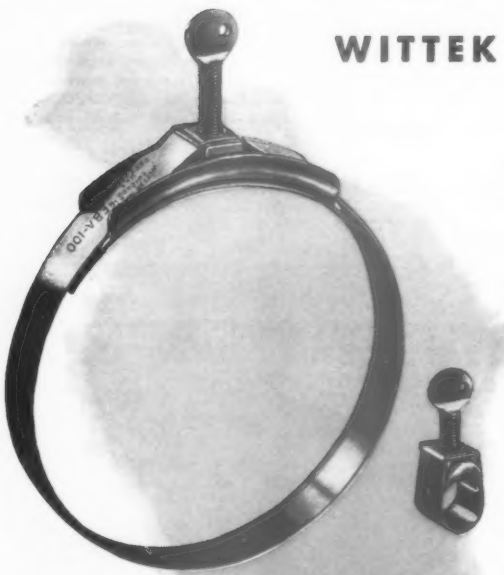

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For Dependable Hose Connections

Since the beginning of modern aviation Wittek has been a producer of hose clamps for that industry. From the epic days of 1924 when the U. S. Army Air Corps circled the globe in the three Douglas World Cruisers—to the present era of advanced military aircraft, Wittek has kept pace with the requirements of the industry for dependable hose clamps.

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Drawing from actual photograph of Beechcraft AT-11 Bombing Trainer

● Fledgling crews must accomplish countless bombing training missions at home before they are ready to take their place in America's far-flung armada of bombers.

Constant take-offs and landings by bombing trainers test the mettle of tires equally as much as heavy bombers themselves.

General Tires proved equal to their mission of safety on the flight to Tokyo . . . and they are proving that they have the quality and strength equal to the mission of standing the gaff on bombing training flights.

In every branch of wartime aviation, General's long practical experience in aviation tire manufacture is helping to bring the utmost in *safety*.

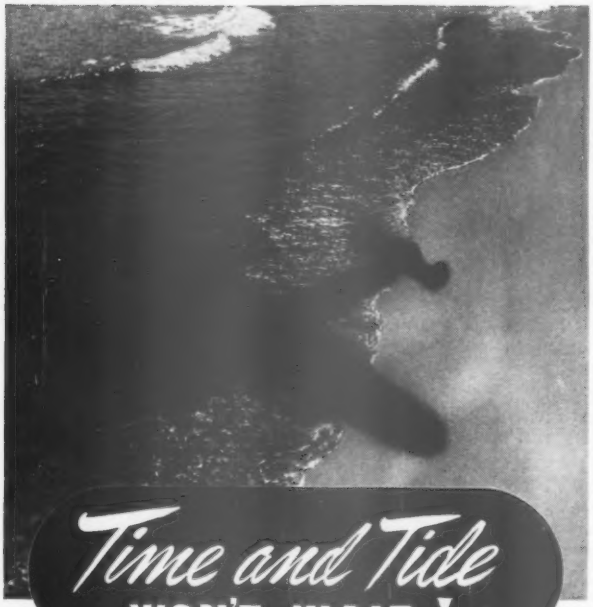
For your safety, too . . . depend on General.

See Your Fixed Base Operator or Write

THE GENERAL TIRE & RUBBER CO.

Aviation Division, Akron, Ohio

—KNOWN AROUND THE WORLD FOR QUALITY AND SAFETY



Neither Will the Enemy . . .

Unless you have training of some sort, you can't contribute your part to the War Effort, and due to the demands of the Army and Navy, this throws the burden squarely on the shoulders of those under eighteen, those over forty-five and—WOMEN.

There are 22 separate, important jobs in aviation women can do. Get training NOW!

We are offering Specialist Courses in Radio Communications, Instrument Technician, Aircraft Drafting and Design, and Career courses in Engine Mechanics and Aircraft Mechanics.

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AT DEADLINE

by MAX KARANT

AMERICAN bombardment successes over occupied France almost surely are going to have their effect on Royal Air Force strategy and tactics. While the RAF officially admits it is vastly pleased with the success of American tactics, it will only go so far as to announce that a combination of U.S. bombers by day and RAF bombers by night will bring Germany to her knees. We look for more significant changes than that.

For instance, the RAF at last can see what heavy defensive armament can do against enemy aviation. British bombers have relied entirely on the .30 caliber machine gun to defend its bombers against enemy fighters—fighters which now carry four 20 mm. cannon and an equal number of machine guns. In contrast to the eight .30 caliber guns on a Short *Stirling*, the U.S. *Fortress* carries 12 .50 caliber guns and one .30—many times the defensive firepower of the British bombers.

So comparatively weak armament, plus antiaircraft, have given the RAF proportionately larger losses than those of the U.S. Bomber Command. As a matter of fact, one of the most important reasons for the British turning almost exclusively to night operations with its heavy bombers was the fact that German fighters took heavy toll whenever daylight flights were made. The American *Fortresses* have shown the RAF that, while each plane's bomb load is reduced, a larger percentage of airplanes and crews—each representing an investment of a half million dollars—get home after each raid.

Another change we may see soon is a renewed interest in our bombsight. While previously looked at as another American gadget, it too has shown what it can do in actual operations. Although British pattern bombing has been developed to the point where it is highly effective, it still is not possible for RAF bombardiers to put a single bomb on a predetermined spot almost at will.

* * *

AS this issue went to press the Office of War Information released its much-discussed "report" on American military aircraft. Substantially, the report said little more than is contained in "Look at the Record!" on page 25. It does, however, include some criticism along with its praise. Inevitably, the culprits are the P-40 and the Allison engine. Some criticism is deserved; much of it is distorted or unjustified. The original P-40 was not designed as a high-altitude fighter, therefore should not be criticized for not being one. The Allison engine was full of "bugs" and everyone in aviation knew it. But there never has been a new aircraft engine—including our superb air-cooled radials—that hasn't had "bugs."

The Allison engine in production today is, in many ways, superior to the tried and true Rolls-Royce *Merlin*. But little mention is made of this fact—nor is there emphasis on the fact that current models of the P-40 now operate normally at altitudes many thousands of feet higher than anyone will admit. We realize we are hedging with that statement; we are forced to beat around the bush in nearly everything we say, for purposes of military secrecy. If those of us in the aviation industry were at liberty to print what we know, much of the criticism heard these days could be quieted quickly.

* * *

USUALLY there are only three pages and four or five new silhouettes to our "For Identification" department each month, but what a multitude of headaches there are in that comparatively small part of each issue! The preparation of the silhouettes themselves are by far the most difficult job of all. Each drawing takes from eight to 12 hours work by skilled draftsmen, depending upon the airplane being drawn and the amount of research material available. Once the finished drawing is complete, photostats go to every logical source for careful checking. Drawings of American aircraft naturally go to the engineering departments of the manufacturers involved. There, at our specific and detailed request, every hinge and

(*Continued on page* 149)

"Guns" That Shoot 3000 Miles—!

Today, in ever-increasing numbers, America is building "guns" that shoot *4 tons* of projectile more than 3000 miles.

These "guns" are the huge, four-motored Consolidated Liberators (B-24's)—the first heavy bombers ever to be built on a moving assembly line. The Liberators can reach any front in the world under their own power and *are doing so every day.*

The thousands of employees of the Consolidated Aircraft Corporation who build the Liberators, Catalinas, and Coronados, are *buying* them for Uncle Sam, too. They consider the money they invest in War Bonds as their own personal contribution toward a fitting reception for the "new order."

Consolidated Aircraft Corporation, San Diego, California. Member, Aircraft War Production Council, Inc.

He mistook . . .
FOR FERDINAND FUTTS PLEASE LIGHT UP A CANDLE,
HE MISTOOK THE FLAP FOR THE LANDING GEAR HANDLE;
HE OVERSHOT, UPPED WHAT HE THOUGHT WAS THE GEAR,
BUT FOLDED HIS FLAPS AND FELL IN ON HIS EAR.

Reproduced in the interest of safety, by permission of the Army Air Corps.

CONSOLIDATED* builds Battleships of the Air

*Originator of the LIBERATOR . . . CATALINA . . . CORONADO

The Birdmen's Perch

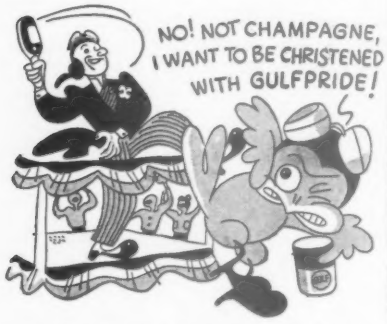
THE NAMES FOR OUR Canary Commando were wonderful, gang!

We wish we had a dozen Oily Boids so that we could call them "*Blunderbird*," "*One Wing Low*" and "*Rudderduck.*"

And even Oily howled at "*Luberator*" and "*PB ½.*"

He didn't seem to like "*Gasolini*" or "*Burblebird*" or "*Airacoma*"—but we did!

But the life-size portrait of Oily goes to a girl! Mary Bennett, of Englewood, N.J. sent in the name we liked most... the name that most perfectly describes our 4-F Fowl.



Perch Pilots, meet "*FLUTTER*," the Oily Boid.

Major Al Williams

alias, "Tattered Wing Tips," Gulf Aviation Products Manager, Gulf Bldg., Pittsburgh, Pa.

BRAINTWISTER

A pilot had to fly from Pittsburgh to Detroit on business. He left home in the morning accompanied by his wife, who saw him off and waited at the airport until his ship was out of sight. He flew to Detroit non-stop, and the first person to greet him was his wife. She'd not travelled by train, road, or plane. How did she get to Detroit?

When you send your post card for the answer, send us your brain-twister, too. Complete with answer, please.

SOME-DIAL!

You Perch Pilots who fly twin-engine jobs will soon find it much easier to check your instruments.

A new whingdinger of an instrument combines the readings of three instruments (2 tachometers and a synchroscope) *on one dial.* You get an rpm reading on BOTH engines and see how much out of synchronization they may be at a glance. Removing the two unnecessary dials disposes of deadweight, and the remaining dial does more work.

Lubricants refined by old-fashioned methods had parts which made sludge and parts which formed carbon—in addition to the part which did the actual lubricating. To get rid of these unnecessary parts of petroleum, Gulf engineers devised the Alchlor Process, which removes *more* of these two deadweights from Gulfpride. And the remaining oil does more work.

Better try it.

POWER OF THE PRESS DEPT.

It's been some time since we felt obliged to open the musty doors of our POTP Dept.

But we'd like to remind you of a letter from "Great Circle" Gribbin, in July's Perch. Part of his whopper said, "*A while back you mentioned a tailless plane without a fuselage. It seemed like the wrong approach to a good idea. A wing is bound to contribute to drag. I tried to solve the problem of drag in a different way. I made a tailless plane without a* wing."

Now read this, from a recent newspaper:

"A wingless airplane dubbed the 'Flying Flounder' has been successfully flown more than 62 times by its inventor. The plane looks like an elliptical pancake and does 190 mph."

Well—?—

Bet he used Gulf Aviation Gasoline, too.

Gulf Oil Corporation and Gulf Refining Company... makers of

GULF AVIATION PRODUCTS

OIL IS AMMUNITION—USE IT WISELY!

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...IN FLYING CONDITION, ESPECIALLY IF THE PLANE IS "ON THE LINE" WHILE...
...UNDERGOING REPAIRS OR ADJUSTMENTS, AND...
PUT A TAG ON YOUR GAS ...TANK, SAYING...
NOTHING BUT THAT GOOD GULF AVIATION GASOLINE PLEASE!

Ready

WHEN YOU NEED IT...

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Franklin service is fast, economical and exact. Franklin service stations, strategically located throughout the hemisphere, have the parts and equipment to serve you quickly with emergency overhaul or parts replacement. Franklin design, standardized to provide interchangeability of parts, makes for readier availability of parts and easier replacement.

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Franklin

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He Trains to Serve His Country as an INSTRUMENT TECHNICIAN

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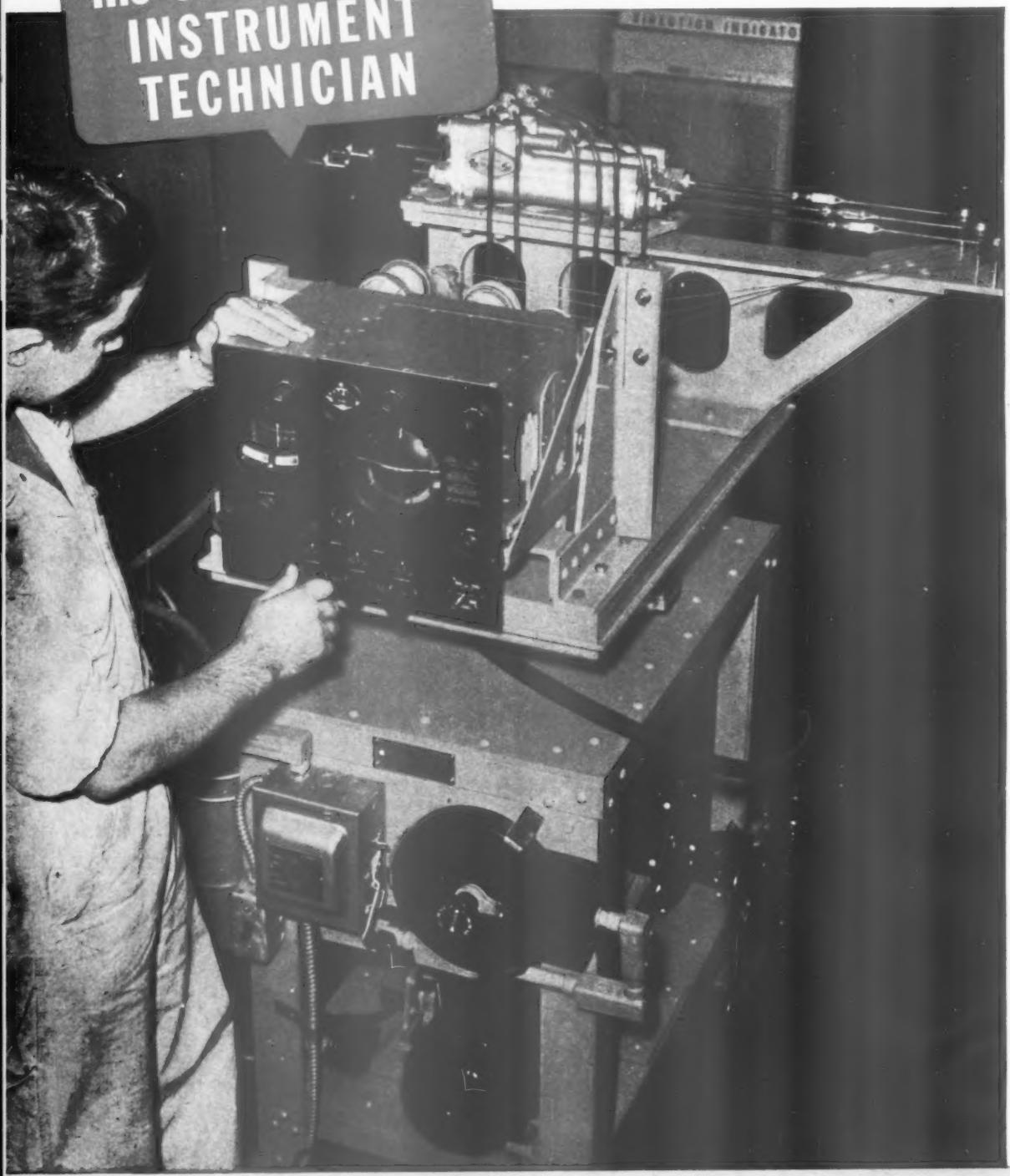

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The SPARTAN instrument student pictured above is gaining actual experience testing Sperry automatic pilot on the Scorsby. Because he has all of the late equipment with which to work he will have the "know how" when he graduates to rate as a valuable technician in the aviation industry. $2,000,000 worth of training facilities are available at SPARTAN to assure you training of the highest caliber. SPARTAN is Government Approved . . . rated as the outstanding civil aviation training school in America . . . industry-recognized for turning out excellently trained graduates. *NOW is the time for YOU to get a speeded-up specialized education!* MAIL THE COUPON for the new 64-page SPARTAN catalog giving complete information. NEXT SEMESTER STARTS January 4th.

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SPARTAN instrument graduates are being placed upon graduation with airlines, instrument manufacturers, aircraft factories, the civil service and many schools needing instrument instructors. Most of SPARTAN'S Instrument Technicians are hired long before they complete the course, and report for duty immediately upon graduation.

SPARTAN

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Previous Education.....

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- ☐ Airline Communications
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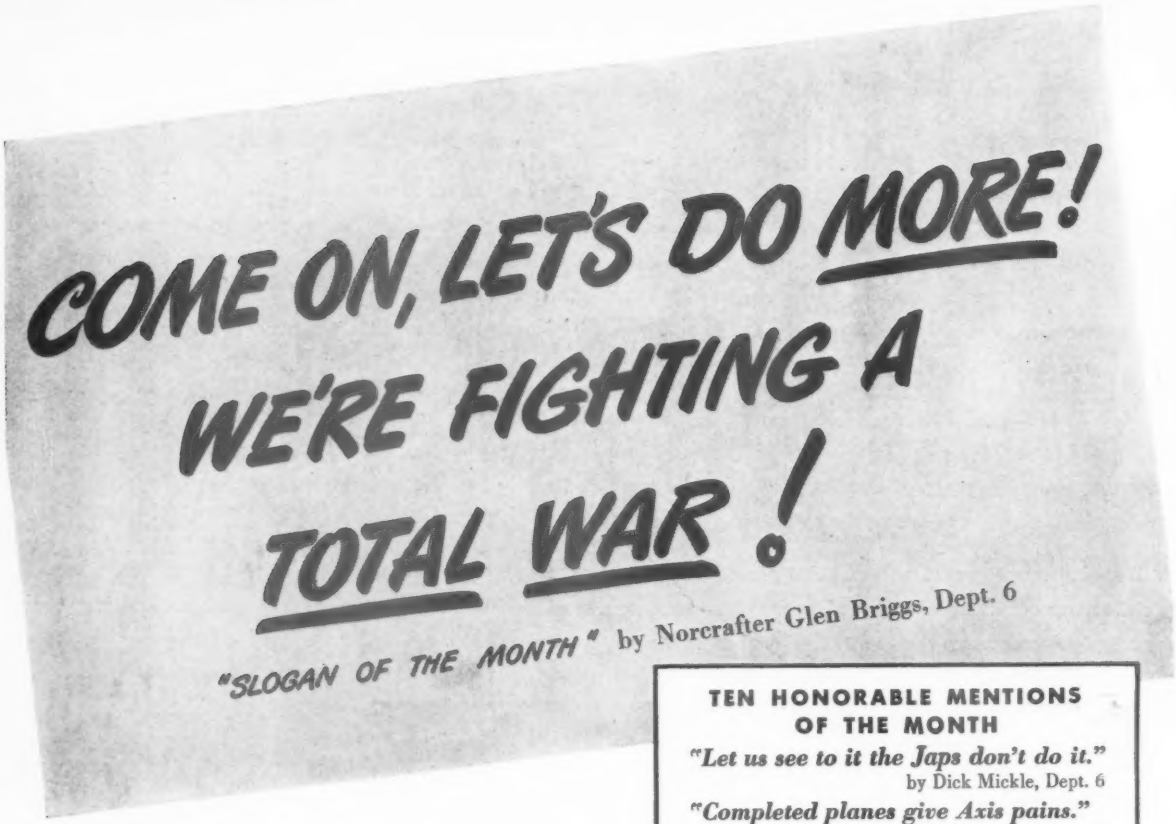
- ☐ Instrument Technician
- ☐ Women's Instrument Technician



Sentiments like these
***by Northrop people* are speeding our production progress**

The "Slogans of the Month" posted about our plant are something visitors almost invariably praise. We are proud of them, too, for every one is the creation of the men and women *who are doing the job at Northrop.*

Since the month of April, more than 1200 such slogans have been turned over to our War Production Drive Committee. Norcrafters from virtually every department in the plant have submitted slogans. It has been a lot of fun. But more important, it has had a very real effect in stimulating us all to *"DO MORE."*

TEN HONORABLE MENTIONS OF THE MONTH

"Let us see to it the Japs don't do it." by Dick Mickle, Dept. 6

"Completed planes give Axis pains." by W. F. Schneider, Dept. 18

"Save your scrap to lick the Jap." by Seymour Block, Dept. 52

"Let's change Hitler's creed by Northrop's speed." by Don Roberts, Dept. 25

"Every bomb in the rack is a Jap in the sack!" by R. E. Tobiason, Dept. 52

"If we work as a team, we'll stay on the beam." by W. L. Kilgore, Dept. 50

"Let's give it the gun, 'til the job is done." by Bud Southwick, Dept. 43

"It's what you do today, not tomorrow, that counts." by Don G. McCarthy, Dept. 8

"Shall we get behind victory or, just get behind?" by William Chandler, Dept. 5

"Build those planes, make that dough, loan it to Uncle Sam, and just watch him go." by R. W. Cowdery, Dept. 3

NORTHROP AIRCRAFT, *Inc.*

Northrop Field, Hawthorne, California

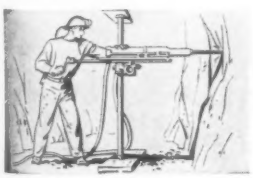
MEMBER AIRCRAFT WAR PRODUCTION COUNCIL, INC.

TO KEEP 'EM LANDING...

CLEVELAND PNEUMATIC PRODUCTS

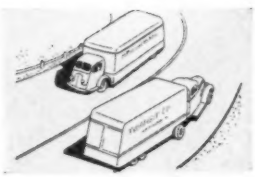
serve from the mines to the flying fields!

In the production of Cleveland Pneumatic Aerols*, which keep 'em landing safely and smoothly, all of the other Cleveland Pneumatic products play an important part.

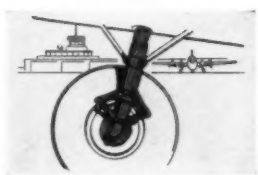


MINING. The first step occurs underground where Cleveland rock drills help extract the iron ore as well as the other minerals used in Aerols.

METAL WORKING. Later, Cleco pneumatic tools, such as chippers and grinders, aid in finishing the metal forgings from which Aerols are made.



TRANSPORTATION. Cle-Air shock eliminators help speed deliveries on many trucks transporting the raw materials and the parts for Aerols.



MANUFACTURING. Finally, at our own huge plant we manufacture the world-famous Aerols which are supplied for all types of airplanes.

Thus, from the mining of the metals to the time when the plane lands on Aerols, Cleveland Pneumatic products contribute to aviation's progress. The Cleveland Pneumatic Tool Co., Cleveland, Ohio.

AEROLS*

*THE SHOCK ABSORBING UNITS ON AN AIRPLANE'S LANDING GEAR; THE NAME IS DERIVED FROM THE WORDS "AIR" AND "OIL" — THE FLUIDS USED TO DISSIPATE THE LANDING SHOCKS

JACOBS AIRCRAFT ENGINE CO.
POTTSTOWN · PENNSYLVANIA · U·S·A·

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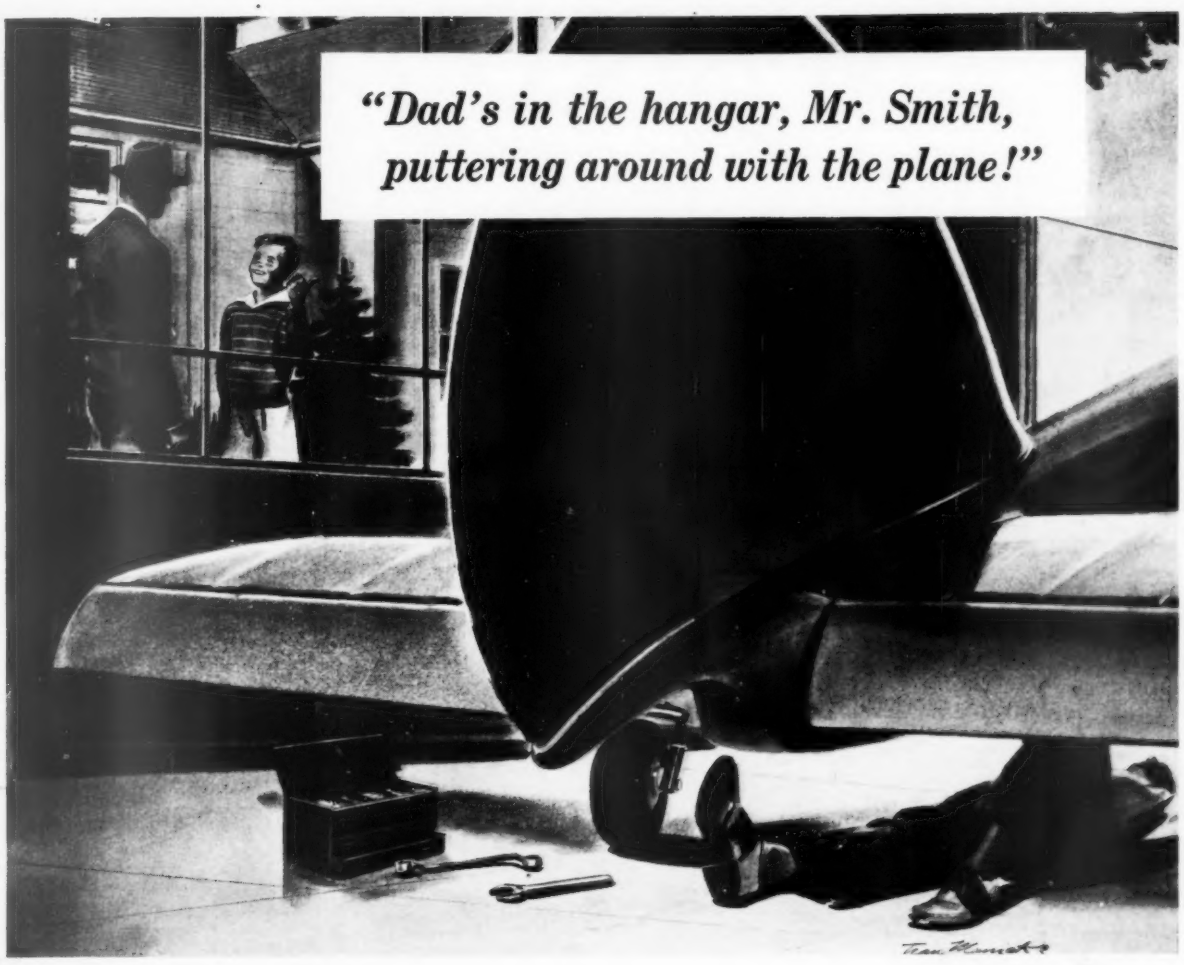


AMERICANS love to putter with things mechanical. They do now. They will in the future.

It's this restless, inquisitive trait in our national character that has set the pace for the world of the present . . . that will build the new America.

And what an America it will be! More wonderful than anything you've even dreamed about. How do we know?

Because we can already see it on the horizon. We can see it in the skill and ingenuity of the men now working night and day in the arsenals of democracy. These are the hearts and hands that will shape it.

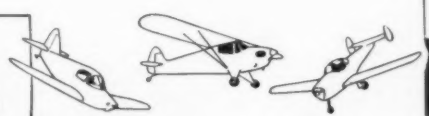
These men, who are now making the world's best combat and training planes, will be making family planes for us. These men, now building bombing planes that are the envy of a warring world, will be making luxury transports and super-cargo carriers of the air.

How far off is the birthday of this new America? Not very . . . because our hearths and furnaces and production lines are already forging Victory.

You'd feel as confident as we if you were in B. F. Goodrich plants now . . . if you had seen what our Aeronautical Division has developed in the short span of a single man's life. Giant tires that bring a Flying Fortress to rest as gently as a tiny sparrow. Brakes that halt a ship that flies faster than sound can travel. De-Icers that defy the elements.

Today, this B. F. Goodrich equipment goes to the air forces of the United Nations. It flies with planes that make history over Wake Island, Burma, Tokio, and the Sahara. But *tomorrow* it's going to help make a different kind of history. *It's going to help America create the new world!* The B. F. Goodrich Company, Aeronautical Div., Akron, O.

HERE ARE SOME AMERICAN PLANES THAT ARE SUPPLIED WITH B. F. GOODRICH EQUIPMENT



CULVER PIPER ERCOUPE

Skyway or Highway

B.F.Goodrich

FIRST IN RUBBER

WANTED: Some Clear Thinkers

by CHARLES I. STANTON
Administrator, Civil Aeronautics Administration

The chief of our civilian and commercial air administration decries the ballyhoo and wild prophecies of glider and cargo plane zealots.

Charge that we lack a cargo plane program is refuted by a glance at this Curtiss C-46 production line.

I HAVE accepted the invitation of the editors of FLYING to discuss the glider and the cargo plane because I believe that current publicity on both topics typifies a basic danger today threatening the aviation industry and the public.

Headlines have distorted the facts. The danger to the public is that they will expect the impossible from gliders and from cargo planes. The danger to the industry is that, for all the miracles its leaders have performed within the last year, they cannot do the impossible—fulfill all the glowing promises of the propheteers. The result might be a disillusioned public, a disgruntled industry and an overall damage to national morale at a time when national morale should be at its peak.

I submit that the solution for this condition—like the solution of all such problems in a democracy—is facts.

In saying these things I have no intention of setting myself up as an expert or a spokesman for the industry. I am neither. The Civil Aeronautics Administration is staffed by men who have devoted their lives to the various highly technical problems of aviation. I am simply consolidating and reporting some of our findings. Let the public draw its own conclusions.

American exuberance is written in the headlines, but its history has been a fine-print epic devoted to the glorification of horse sense.

Consider first, then, the facts about the glider. I know of no invention that deserves more praise. It was in a glider that man first flew, writing the opening chapter of modern aviation history. Speaking of facts, the man was an American and not Otto Lilienthal, as popularly supposed. Lilienthal did not fly until the early 'nineties. Nearly a decade before, in August, 1883, a 26-year-old experimenter, named John Joseph Montgomery, glided off a cliff near San Diego, Calif., adding another and little-known "first" to U. S. aviation history.

The Wrights were experimenting with gliders—and flying them—in the summer of 1900, at Kitty Hawk, N. C., more than two years before that historic December day when they made their first powered flight. Before 1900, Octave Chanute, the Indiana civil engineer, was flying with associates from the sand dunes along Lake Michigan, and if you want to go back into the dark ages of aviation, Sir John Cayley of England propounded theories of glider flight in the first two decades of the 19th century that the American pioneers proved in practice in the last two decades. The glider wasn't a postscript in aviation during that century—it *was* aviation; but for it, powered flight might have been delayed for many years.

With the coming of the airplane, gliding and soaring continued to play major roles in the progress of aviation, as they do to this day. Experts who spent most or all of their time gliding or soaring, are responsible for outstanding contributions in aerodynamics, structure and dynamics of the atmosphere, and in allied fields.

Public interest in gliding and soaring—always accompanied by wide publicity—has been less sustained and, in many respects, less beneficial. The layman, periodically "discovering" the glider, has generally expressed his enthusiasm in hyperbole. Then, like a kid graduating from a soapbox auto to a motorcycle or the real thing, he has turned to power. Amateur adventures in gliding and soaring can best be told in terms of epidemics. There have been three.

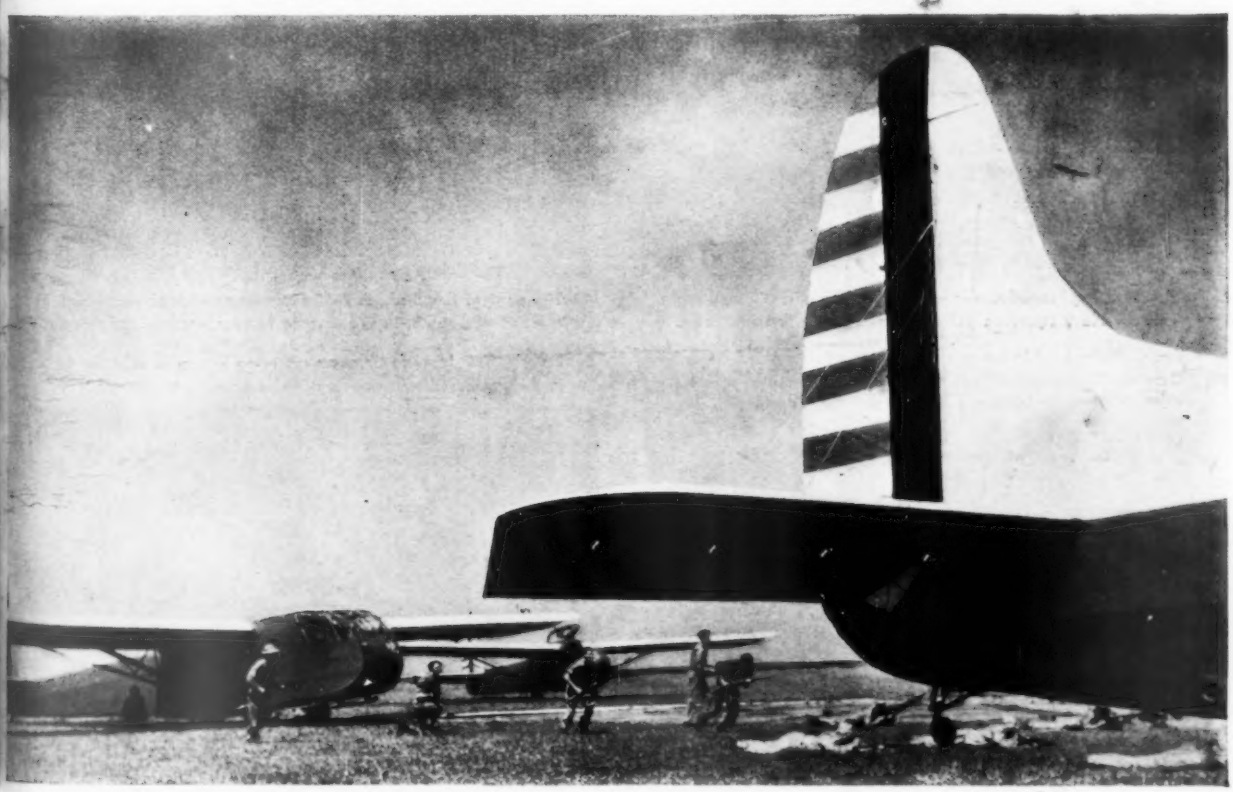
The first was in 1912, when gliders first gained world prominence as the result of a meet, mostly German-inspired, held on the Wasserkuppe in the Rhoen Mountains.

World War I eliminated meets for the duration, but a second was held in 1920. By 1923, another epidemic was at its height, with meets held all the way from Itford Hill, in England, to Algiers.

The third epidemic reached its apex in 1929-30, with the United States leading the way after continental glider stars were imported by Col. Edward S. Evans, a Detroit manufacturer, and by J. C. Penney, the chain store operator. Soaring came into its own, records were broken right and left, the National Gliding Association was formed, clubs sprang up all over the country. Towing was the rage. Following tests in 1927, by several experimenters, Dale Drake was towed 200 miles in a glider in California. Wolfgang Klemperer, one of the imported

(*Continued on page* 108)

Use of gliders such as the Army's new 15-place Wacos would be frowned on in scheduled air service.

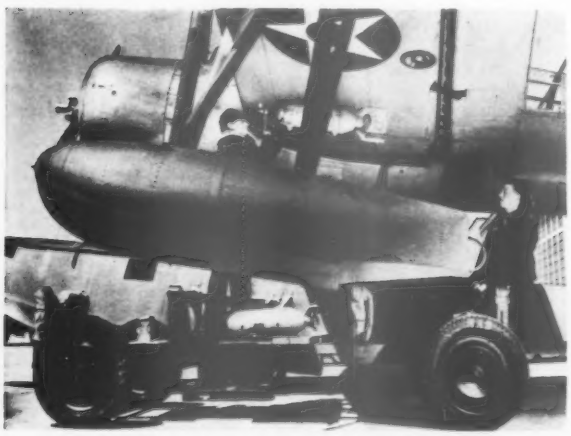


WAR IN THE AIR

Carrier crew works swiftly to remove crashed "Wildcat" from path of landing planes.

Mounting victories against the Axis are chalked up in all theaters of war where fighting wings play major role.

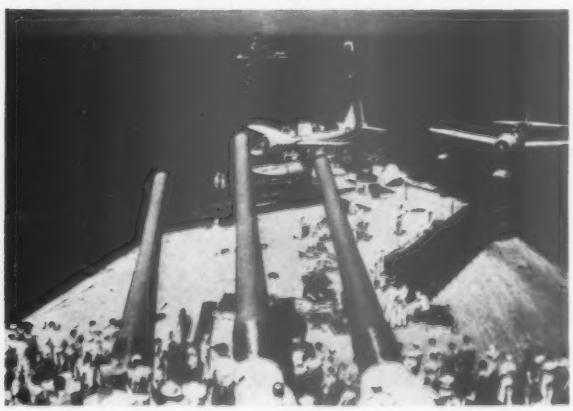
First U. S. plane to land on Jap airport captured after first Guadalcanal battle was this Consolidated PBY-5A amphibian.



Bombs being loaded under wings of a "Kingfisher" seaplane used by Navy squadron patrolling off of New England coast.

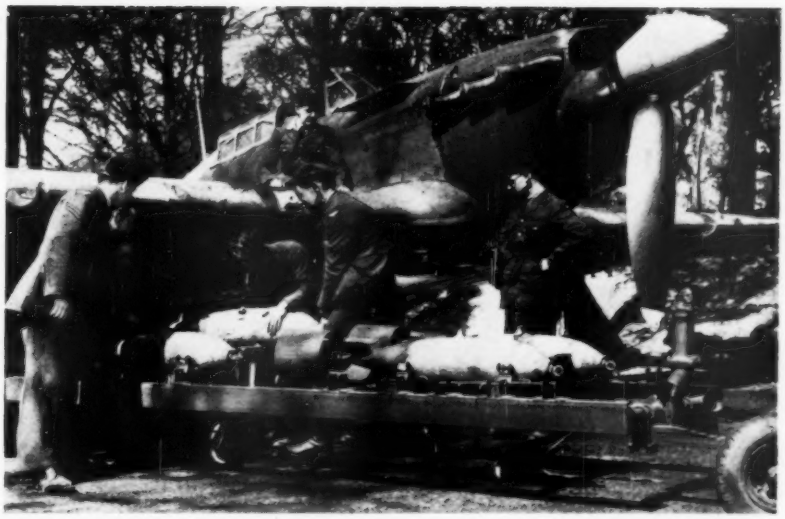
The pilot of this Douglas A-20 later reported that plane had reached 452 m.p.h. in this dive to inspect wrecked freighter.

Two OS2U's about to be catapulted from deck of U.S.S. "North Carolina." This 35,000 ton warship carries three such craft.



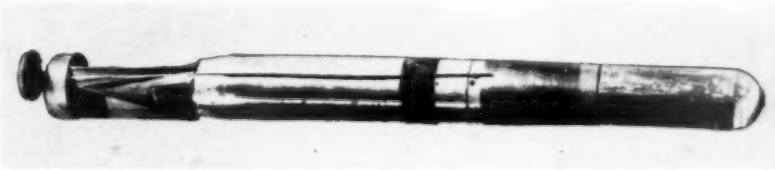
Douglas TBD torpedo bombers returning to carrier after foray in the Pacific. Smaller boats guard carrier from sub menace.

One elevator control wire remained when Nazi shell hit this "Spitfire." But the RAF pilot flew craft 150 miles to safety.



"Hurricanes," their machine guns augmented by load of two 250-pound bombs, have earned RAF nickname of "Hurribombers" and play important role in daylight raids.

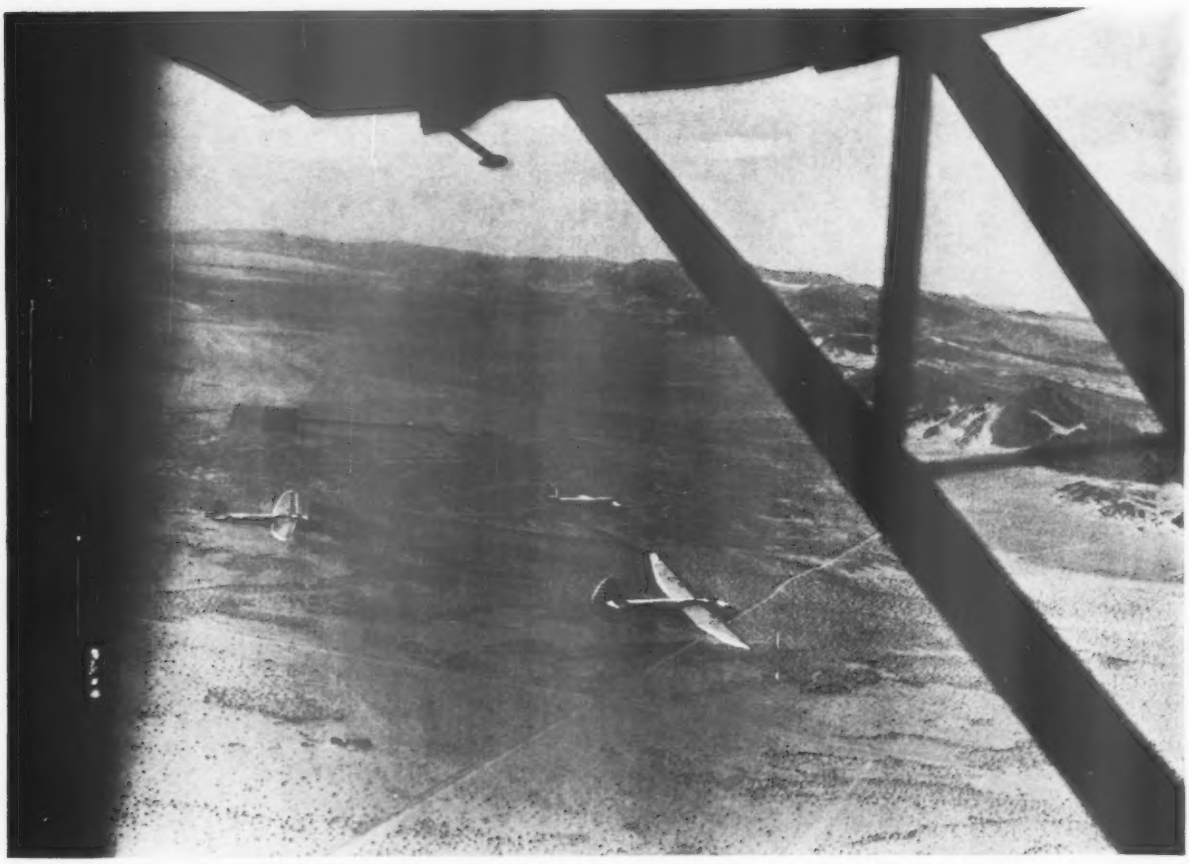
Jap bullet passed through hip pocket of this "Flying Fortress" turret gunner. It was deflected by metallic flashlight top.



The new Nazi incendiary bomb carries a small explosive charge in nose, fired by a slow fuse. This was designed to explode as victims strive to extinguish blaze.

Covey of Vultee A-31's ("Vengeance") in formation flight over American desert as planes, tanks and artillery practice under conditions prevailing in North Africa.

Note turret over cabin and gun opening in baggage compartment of this Douglas DC-3, converted by Russians.



Three Army sailplanes on a triple tow from airplane. Note runways of training base in background.

Sailplane Seminary

by HOWARD E. JACKSON

The Army Air Forces is operating an unique training base in the Mojave Desert. The airport site is an ancient dry lake.

GLIDER PILOT CADET THOMPSON looked down at the desert below him and then along the great trough-like valley between the long mountain ranges to the horizon. Despite perfect visibility he could scarcely see his objective—the air academy.

He was in a tight spot. The warm air currents which had carried him so far from the airport were petering out. It wasn't that he was afraid of crashing into a rocky slope or the cactus studded desert. The glider would probably be "washed out" but because of its slow landing speed he would not be hurt. It wasn't that he was afraid of injuries, the long wait for rescue or the weary walk to the nearest habitation.

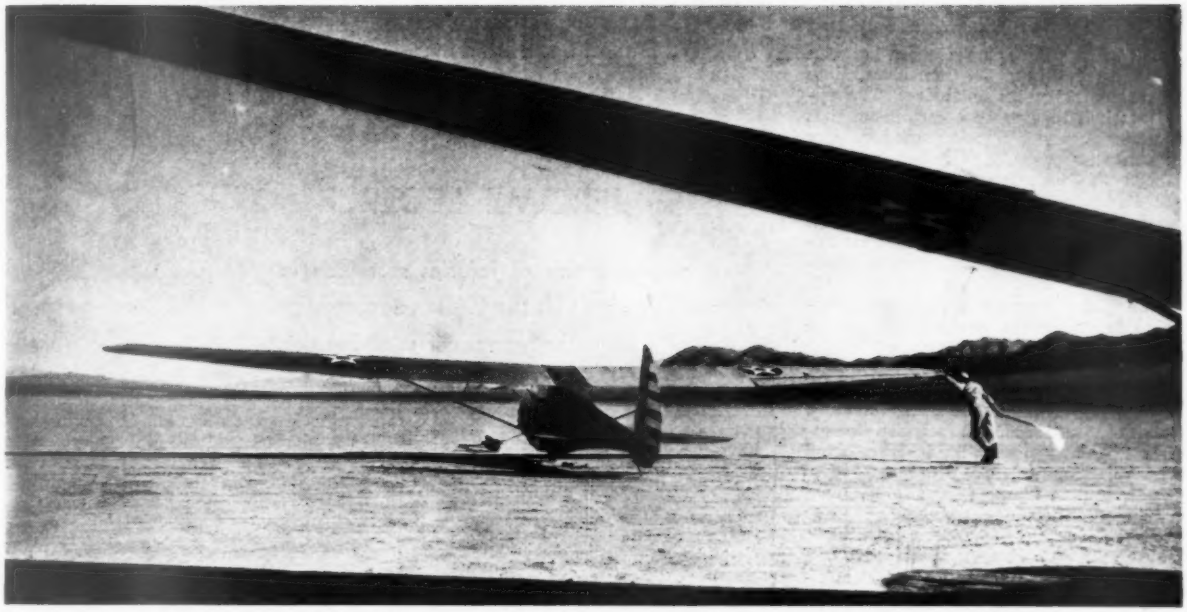
But he was afraid he might lose his chance to serve his country as a glider pilot. He had hoped, in the very near future, to pilot one of the Army's huge transport gliders, carrying airborne infantrymen equipped with machine guns and grenades, over similar chaparral country on the setting sun side of the globe!

He cursed himself for a fool and headed toward the northern mountains. His one hope lay in slope soaring along the ridge as far east as he could go, and then to glide toward the field. He lost valuable altitude gliding toward the ridge and came close to crashing, but was lifted over the top by the hot air currents sweeping up the slope.

For the next hour he played tag with the mountain peaks. After rising as high as he was able on an air current he would glide eastward, losing altitude but picking up another current just before he crashed into the ridge. Slowly the airport grew more distinct.

But the air currents grew weaker and weaker; atmosphere cooled. His margin of safety decreased. A forced landing seemed imminent. His "bird sense" saved him temporarily when he followed a couple of buzzards who soared ahead of him. But at last it was either crash or head out over the desert. He pointed the nose southeast toward the nearest edge of the airport.

There were no more currents to help him. It was just a matter of plain gliding, holding the nose up as much as possible without stalling, gaining 23 feet



Signalman steadies wing as glider awaits pull-off. Note parachute to keep towline from tangling when dropped.

forward for every foot lost in falling. His ship headed slowly toward the desert, skimmed the tops of the mesquite bushes, cleared a barrel cactus by inches and landed—on the edge of the field!

Neither the glider pilot nor his sailplane were injured. The incident is true, though the name of the pilot is fictitious. The airport on which he landed is an ancient dry lake, Mesquite Lake, in the Mojave Desert where the Army Air Forces is operating one of the most unique training activities of the war.

Twenty-Nine Palms Air Academy, the first and finest Army glider school in the country, is 143 miles east of Los Angeles. The country is desert and the town consists of the palms (yes, there are 29) and the "four corners." The academy grew up at the end of the pavement, six miles north of the four corners.

The site was chosen for many reasons including: meteorological, excellent year-round gliding and soaring conditions; size (needed for take off of a train of gliders hauled by an airplane); number of dry lakes in vicinity, to be used in case of expansion, emergency landings, cross country soaring and practice military maneuvers.

The California Glider School, originally a civilian school with a single glider and a couple of students, was taken over by the Army about the first of this year, and since has operated by contract under Air Forces supervision.

The first class started about the middle of January and was graduated during the latter part of February. Construction of barracks and other buildings was still in progress. In the meantime the students lived under canvas some distance from the field, pending completion of water supply piping to the site.

Today the post is complete, right down to the signs along the approach: "Photography Prohibited by Federal Law"; "No Parking at any time, by order of commanding officer"; "U. S. Army Air Forces Training Detachment, closed area by order commanding officer." There is a huge paved parking area, enclosed by a wooden fence. The gatehouse and all other buildings are of wood, the lower half of the siding being yellow and the upper half cream colored and with light green roofs. These air-conditioned units are arranged U-shaped with a popular and much used outdoor swimming pool in the middle. Trees have been planted in front of the administration building.

Officers and cadets wear snappy Army uniforms and the white-haired gentlemen who guard the gate wear light grey uniforms with blue shoulder straps, side arms and pith helmets, adding atmosphere to this desert outpost.

At first, classes were limited to Air Forces officers who not only had qualified as airplane pilots but who also had served as airplane pilot instructors. The Air Forces found that the average flyer who had soloed in a powered plane could learn elementary gliding within four weeks, during which time he was given

Classroom study is important part of course at Twenty-Nine Palms. Blackboard drawing illustrates the relative positions of towing plane and glider before they separate.

a total of 30 hours of flying time.

Then admission was opened to any Army officer or enlisted man between the ages of 18 and 32, then changed to 18 through 35 years, inclusive. The applicant had to possess a certain amount of glider or power plane experience. Any citizen who wanted to enlist but who lacked the necessary experience could get it through Civilian Pilot Training, under the Civil Aeronautics Authority. (Applicants can find out the latest requirements at any Army Recruiting Station.)

The glider program is so new everything is subject to change. When the Government set up 21 primary glider schools throughout the country the academy became an advanced school.

Training technique, too, has changed considerably since the school's inception. The first classes, for instance, tried their silent wings in a glider moored to the ground in front of a powerful wind machine. They were taught the four methods of launching gliders, by straight auto pull, pulley tow, winch tow and airplane tow. Today only the last mentioned is used.

Airplane tow launchings are single, double or triple. The single tow is made with a rope about 400 feet long. The double tow is made with ropes forming a Y, one glider slightly back of the other. The triple tow is made with one longer line in the middle and two shorter lines on either side. The tow plane, although powered with only a 295 h.p. engine, can

Portable winch runs cable from glider to power plane waiting to tow it aloft.

easily take off with three gliders in tow.

The training gliders used at the academy are the Schweizer TG-2 sailplane, an all-metal two-place type. The fuselage is of welded tubular construction, with duralumin covered wings, of semi-cantilever construction. The pilot's cockpit is entirely enclosed. A brake is provided for the single belly wheel and rubber blocks under the nose take up the shock of quick stops.

The Schweizer combines the ease of handling of a secondary or utility type

(*Continued on page* 139)

Minimizing Air Injuries

by JEROME LEDERER

A recapitulation of injuries sustained in plane crashes aids the CAB in its campaign to eliminate the source of fatal injuries.

Jerome Lederer

Mr. Lederer, until recently, was director of the CAB's Safety Bureau, resigning to become executive assistant of the Airline War Training Program. As safety director, he was known as the first line detective of the air, as a result of his tireless efforts tracking down the causes of airplane accidents. Born in New York City in 1903, he has been active in aviation since 1924. As chief engineer for Aviation Insurance Underwriters he inaugurated a successful program of accident prevention, winning nation-wide recognition.

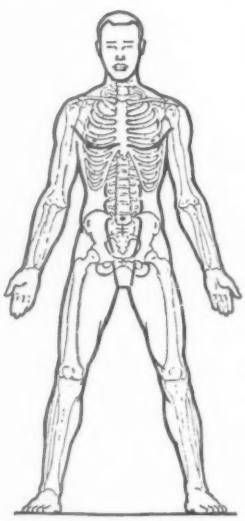
MORE people meet accidental deaths in their homes than in airplanes as a result of slipping in bathtubs, falling off stepladders or just reaching for the wrong medicine bottle in the dark. This does not mean, of course, that an airplane is safer than your home—merely that almost everyone lives in some sort of home and relatively few use airplanes.

Nevertheless, great strides have been made in making the airplane a safe means of transportation. Construction is stronger, engines are more reliable. Radio aids have been provided for flying at night or in bad weather and sensible, strict regulations applying to both pilots and airline companies have been imposed.

The emphasis in such safety programs, however, has been placed almost exclusively on the effort to *eliminate* air accidents, a most worthy objective but one which experience with other forms of transportation indicates is not likely to be completely attained. Recognizing that fact, aviation now is engaged in a drive to lessen the seriousness of injuries resulting from such air accidents as do occur; to see to it, if possible, that instead of fractured skulls and broken bones, victims of air accidents are enabled to escape with, say, scalp lacerations and bruises.

The campaign is being carried on by the Civil Aeronautics Board in cooperation with the National Research Council.

A large share of the credit for initiation of the campaign belongs to a successful New York inventor, Hugh de Haven. It was his curiosity about freak accidents in which the victims escaped serious injury that set him to thinking about the possibilities of minimizing the seriousness of aircraft accident injuries. He had often read, for instance, of cases in which men fell from windows five or 10 stories above the ground but escaped injury because they landed on open awnings, the roofs of automobiles or, less frequently perhaps, a passing hayrick. Why, he thought, couldn't passengers in airplanes which crash have just as much luck? Had everything possible been done to insure that they were not being needlessly injured?



Doctors mark injuries on this standard chart

De Haven brought his questions and his theory to the Safety Bureau of the Civil Aeronautics Board. The current campaign of "protective research" was the first result. It should ultimately produce a substantial reduction in the number of serious injuries received in airplanes, possibly by as much as 50 per cent, and may materially affect the design of passenger and training planes.

As an indication of the need for such a reduction, the CAB's Safety Bureau figures for 1941, show that 35 airline passengers were killed that year and 21 seriously injured, and that 154 pilots and 77 passengers of non-airline planes also were seriously hurt. A total of 185 pilots and 110 passengers of non-airline planes were killed in the same year. (Of the latter passengers, incidentally, many were riding with student pilots in direct violation of the regulations.)

Unfortunately, the kind of detailed anatomical and dynamic data about such accidents which would be necessary to reveal just what caused the injuries is not available. It was for that reason that all Air Safety Board investigators have been instructed to make a study of the factors which cause injuries of any nature to pilots and passengers in aircraft accidents. Spe-

(*Continued on page* 143)

LOOK AT THE RECORD!

Performance data of America's warplanes offers a factual review of their fighting characteristics.

by WILLIAM LEVENOR

The Martin B-26 "Martian" (above) is a medium bomber carrying a heavy bomber's load at pursuit-plane speed. Bell's P-39 (below) has one cannon, six machine guns.

A GREAT deal of confusion has been created in the minds of the general public by conflicting statements as to the relative merits of American vs. Axis warplanes. The one source of accurate facts—the performance reports of the aircraft involved—forms the basis of this general summary.

If the proof of the pudding is in the eating, the proof of the plane is in the fighting. When American meets Jap, when American meets German, which is destroyed? As soon as any imponderables enter the discussion, such as the relative merits and qualities of the flying personnel, the argument becomes one of opinion against opinion, not fact against fact.

The facts have been reported by one who should know what he's talking about —Lieut. Gen. Henry H. Arnold, commanding general, United States Army Air Forces. This is not the place for the weighing of opinions, since we are concerned only with a presentation of facts. Here, in brief, is General Arnold's report:

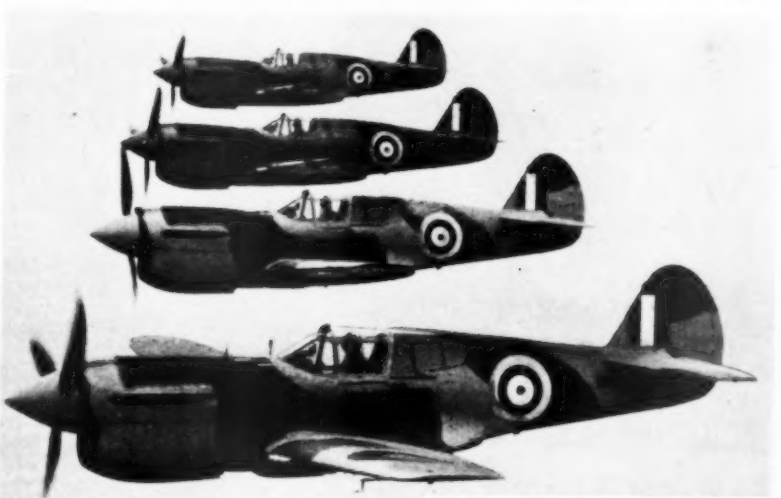
". . . We now find our airmen and airplanes in action in increasing strength on fronts all around the world. They are in successful action everywhere, I am glad to be able to report. They have won victories over every type of enemy aircraft.

"There is ground for solid satisfaction in the record as it stands. Our airmen are proving themselves in actual combat, and I can tell you, without reservation, on the basis of the factual record of eight months of war, that the equipment our men are taking into war also is good. In fact, a great deal of it is better than good; it is superior in quality and performance . . .

"American combat airplanes have met the test of modern war on battlefronts around the world and have performed with a high degree of efficiency even when opposed, as in most cases to date, by numerically superior enemy forces.

"The American-made fighter plane which has seen the greatest variety of aerial warfare is the Curtiss P-40 . . . (which) from the earliest P-40 to the latest and entirely different P-40F, have fought on every United Nations front before and since the entry of the United States into the war. These planes are known to the British as *Tomahawks, Kittyhawks,* and *Warhawks,* according to their position in the series.

(*Continued on page* 74)



Curtiss P-40E "Kittyhawks" (above) are highly praised by the men who fly them.

The deadly P-40E plays a dual role in the RAF when the addition of bomb rack converts "Kittyhawk" to "Kittybomber."

FIGHTER PILOT

by HOWARD WALDORF

Our Army Air Forces have a special technique to help pilots span gap between AT's and P's.

THE important task is this: to safely transfer a United States Army Air Forces flight trainee from a comparatively slow, advanced training plane into the lone seat of a pursuit ship streaking across the sky at six miles a minute.

The follow-up job is to transform the eaglet into complete master of the craft, a qualified fighter pilot prepared to do combat with any foe at any point from the treetops to 40,000 feet in the air.

From the introduction, the single seat of the pursuit plane puts the trainee on his own. Like the parachute jump, there is the possibility of the class being dismissed permanently if he fails to obey the long list of instructions given to him before the take-off. Such as:

"Never allows the air speed to get below 95 m.p.h. Better keep it above 100. In the approach stay above 120.

"Watch the traffic. That air speed. Oil pressure. Manifold pressure. Don't forget to lower and *lock* the landing wheels before landing. Don't trust the indicator. Check the position of the gear by working the handle.

"Watch the landing run. Don't play with the brakes; they burn out quickly. Don't dance on the rudder pedals. Watch everything always."

All the while stories heard during cadet days are whirling through the trainee's head.

"Watch out for those pursuits. They let you down without warning. Get them over on their back and the engine quits. Open them up, the oil boils over and the motor freezes tight. Hold your breath when you land—they're ground-loop crazy!"

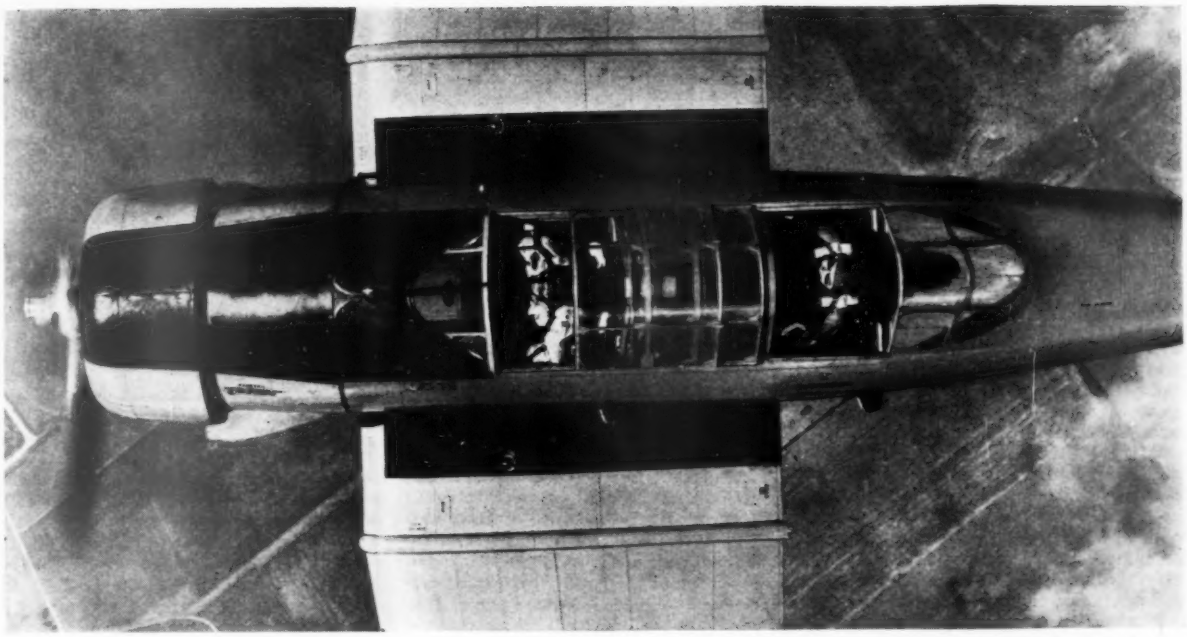
How a new system achieves the objectives and mans the widening stream of sleek fighter craft rolling off the production lines from New York to California is a story that reveals a routine that is unique.

In the confusion of World War I, a system of transition training was hastily developed to provide American fighter pilots. In a sense, this system has been revived—but with modern life-saving developments, including such things as a blindfold test, landings on clouds 7,000 feet in the air, and taking off and landing inside a hangar.

An instructor explains the situation to a trainee:

"You have completed the 200-hour flying cadet course and have won your wings and commission," the officer is

Pilot has no instructor to fall back on when flying this P-40E "Kittyhawk."



Basic training in this North American BT-14 is one of the steps in preparing today's combat pilot for the responsibility of handling a 400 m.p.h. pursuit like the P-47.

saying, "but as far as we are concerned you are just a pilot. Our job is to make you a fighter pilot.

"All the way you've had the company of an instructor whenever you tackled anything new in the way of plane or maneuver. But from now on you are on your own. The instructor must watch from the ground or another plane.

"The pursuit or fighter plane costs from $50,000 up and you represent an investment of $25,000, so you can realize how carefully the details of the transitional training have been worked out.

"This training will occupy your full time for the next two or three months, depending upon the weather and your aptitude—or it may eliminate you as unfit for pursuit duty after the first lesson. If you stay, you will get 60 hours of 300 m.p.h.-plus flying and 172 hours of ground instruction in armament, gunnery, radio and code practice, chemical warfare, meteorology, physical training, high altitude combat, airplane inspection, signal communication and Spanish."

With that the officer trainee is introduced to the particular pursuit plane with which the squadron is equipped. In this case it is a Curtiss P-40.

The first step in the transition is a double-check to make sure no mistake was made in assigning the trainee to pursuit. This brings an instructor along for company, but this time a veteran fighter pilot plays the role.

They climb into an AT-6, the standard advanced trainer of the cadet school, and take off to go through every maneuver in the fighter pilot's book. They try them all; and all the while the instructor carefully observes the trainee's reactions.

Step No. 2 rolls out a blunt-nosed P-36, an older and slightly slower (330 m.p.h.) sister ship of the P-40.

Blindfolded, the pilot must reach unerringly for the propeller control, landing gear handle and other gear while his instructor watches closely to observe any fumbling.

"We start with this," the instructor explains, "because it is powered with a radial engine, the type you learned to fly with confidence in your cadet days."

The trainee is seated in the lone cockpit and told to study the instruments. Before him and at his sides are 50 dials, handles, knobs and mysterious military gadgets.

"Photograph in your mind the exact location of each of these to the other," the instructor says. "Fighter planes do not give you time to fumble around in the cockpit. Knowing exactly where the propeller control, the landing gear handle and other devices are located is life-saving information."

At the end of two hours of study the trainee is given a blindfold test. His eyes are covered tightly with a handkerchief. The instructor reads the inventory of the cockpit and the trainee must point to each instrument or device as it is called out. For a double-check, the trainee is spun around several times, to give the effect of a hectic combat, and the blindfold test is repeated.

Next come the hangar take-offs and landings. The plane is jacked up in the hangar and the trainee goes through the complete take-off and landing routine, retracting and lowering the landing gear, operating the flaps and setting the propeller and carburetor adjustments.

As he reports to the hangar for his first flight in a pursuit, the instructor hands him a memorandum titled: "Instructions Prior to Flight in a P-36 Airplane for Recent Graduates of Air Forces Training Center Schools." The instructions and warnings on starting the engine cover four pages. The warm-up procedure takes a page and a half.

Finally, the trainee gets a sleek fighter plane into position for the take-off, his first in a craft of the 300 m.p.h.-plus class. With a careful look around and a nervous waggle of the ailerons at the control tower's green light, he is on his way, faster than he has ever been in his life.

During those first 20 seconds he must check 20 items in the cockpit, besides watching outside traffic. During that brief space of time he accelerates from 0 m.p.h. on the ground to 160 m.p.h. in a climbing turn at 1,000 feet altitude.

As the roaring plane climbs he must ease back on the throttle, then in rapid-fire order must softly apply the brakes to stop the wheels from spinning, operate the handle that retracts them, return the landing gear control to neutral, change the carburetor setting, change the propeller setting, close the cowl flaps and perform a dozen other tasks.

For the first 30 minutes he feels out the airplane. With increasing confidence, he puts it through the various maneuvers. Then he picks out a fluffy white cloud with a flattish top and simulates a landing on its feathery surface. The theory is you can recover from serious mistakes if your first landings are made on soft clouds, while you might not be so fortunate down below.

Cautiously he cuts the throttle and sets the plane in a landing glide. When the

(*Continued on page 122*)

The Wartime Airline Pilot

by

J. H. CARMICHAEL

Vice president Operations, Pennsylvania-Central Airlines

Our air transport pilot personnel has proven a mighty bulwark of efficiently trained flyers. They make possible the speedy movement of men and materials.

WHEN the present emergency started to take shape—long before the kick-off on December 7—a lot of us in the air transport industry began to consider exactly where the airlines would stand if a national emergency were declared. So we were quite prepared when a state of war actually existed. A large percentage of our flight personnel hold reserve commissions in Uncle Sam's armed forces and a word would bring them flying to the colors.

However, in analyzing the airline picture, the Government has rightly recognized the vital part that the industry plays in the victory picture. Ours is not a non-defense industry. The reverse is true. It is our pledged duty to provide a network of fast communications that speeds members of the armed forces, executives, technicians and specialists to every defense center in the nation. In addition to high passenger load factors, our air express and air mail loads reflect the tremendous volume of materials and correspondence that are speeding victory—by air. In recognizing this important cog in our transportation system the Government also has realized that the veterans in the airlines' cockpits are just as important in their present work as they could if called into service with the armed forces.

It was expected that the Government would seek out some of our pilots—both captains and first officers. But we had started to prepare for that event months before Pearl Harbor. We knew that a percentage of our pilots would be called upon to render military service. But in having some of our pilots assigned to armed duty, we took every step to assure that there would be (1) no lowering of our own company safety standards and operations procedures and (2) no interruption of schedules that were "frozen" as of June 1. Those captains (and there are six) who now are assigned to the Air Transport Command—have been replaced by experienced pilots who had been eligible for promotion to captaincies for several months. A particularly close watch has been maintained over these men for more than a year and—in some cases—longer. We are proud of the talent we have in our cockpits.

So actually, there is no basis for any belief that our pilot resources have been tapped by the Federal Government to a point where our standards are not as high as always. If anything, our standards are higher than they were a year ago—because we know there's a job to be done and our sleeves have long been rolled up to do it.

To convince yourself, you have only to query your flight captain. The average PCA captain has had six and one-half years of transport experience and 8,500 hours in the air. It is true that the industry has been growing in recent years. So naturally, the co-pilot of yesteryear has been promoted to the left side of the cockpit.

However, in moving a pilot from the right to the left side of the cockpit, the industry has not in the least lowered the standards of requirements for promotion. The co-pilot of today must climb up the seniority list from the very bottom before he is even eligible for promotion and he can expect promotion only when vacancies exist. With a greater number of co-pilots having been hired in recent years, the seniority list is longer now and there is more opportunity to learn the workings of the cockpit and handling of the command of an airplane under experienced captains.

The younger crop of co-pilots approaches promotion better fitted than did the captain of five years ago. His primary schooling has trained him thoroughly in instrument work and his appreciation for larger and more powerful equipment is keener because he has kept himself technically abreast of developments in the field of aeronautical design, improvements in power plants, propeller engineering, navigation and airline operation. The co-pilot today continues to learn as does the interne in a hospital or the apprentice in any highly specialized field. The time that he spends on the right side of the cockpit is his internship and he absorbs education by practical experience rather than theory. So, when he approaches the time to prove that he is ready for promotion, he believes himself to be ready to face any situation that his tutor captains might have faced in their years of experience. Those of us who are his final judges are the most impartial people in the world when it comes to a matter of entrusting the lives of pas-

(*Continued on page 144*)

HIROHITO'S PALACE MUST BE BOMBED

by JAMES R. YOUNG

International News Service correspondent who spent 13 years in Japan.

ON the next American flight to Japan, two strategic spots must be bombed—the highly fortified imperial palace at Tokyo, and the Grand Shrine of Imperial Ancestors, located at Ise, near the Nagoya aircraft plants.

The imperial palace is located on a plot of ground of 531 acres in the center of the world's most vulnerable capital. The palace and environs are as military in nature as a munitions dump. A small artillery unit is barracked in the grounds. The imperial bodyguard, the elite of the Jap army, is stationed therein. The central telephone switchboard is a clearing house and signal station for air raid alarms. Wires run north about four blocks to the notorious Gestapo headquarters. The main dugout is across the moat, in the basement of the Dai Ichi life insurance building.

Germany's best Zeiss and Bosch anti-aircraft equipment were installed five years ago inside the palace grounds by the imperial household, under direction of Baron Tsuneo Matsudaira, father-in-law of Prince Chichibu.

One of the city's modern fire fighting units is stationed in the palace precincts. The army, standing watch, is under an imperial prince. Some cavalry are kept there in the barns, for the imperial polo grounds.

The entire Jap war machine, functioning as a joint board under the title of imperial headquarters, presided over by the emperor and two imperial princes of the blood, meets in the palace.

All plans formulated for attacks on the United States, China, Australia, Alaska and India, are mapped in the special room which might, on that April midday Doolittle attack, have been occupied, for the imperial commission always convenes at 11 a.m. and adjourns about 1 p.m.

The supreme imperial network of tactics, strategy, communications and planning, center in the palace grounds—the most military objective of the Japanese Empire.

That palace must be flattened. On the next trip, our men must bomb it as viciously as the Sumida River arsenals or the Yokohama chemical, rubber, tank and auto plants.

The grand shrine at Ise is the burial place for Japanese ancestors of the imperial family. If the palace is bombed and the shrine demolished, a wholesale hara-kiri might well follow with the entire government probably being overthrown. Imperial household authorities would commit suicide. The head of the metropolitan police force would kill himself. Premier Gen. Hideki Tojo and his Nazi-trained staff would resign. The minister of war and the head of the imperial western defense command would be put to shame. The Board of Shinto would be tossed out. Hysteria would prevail.

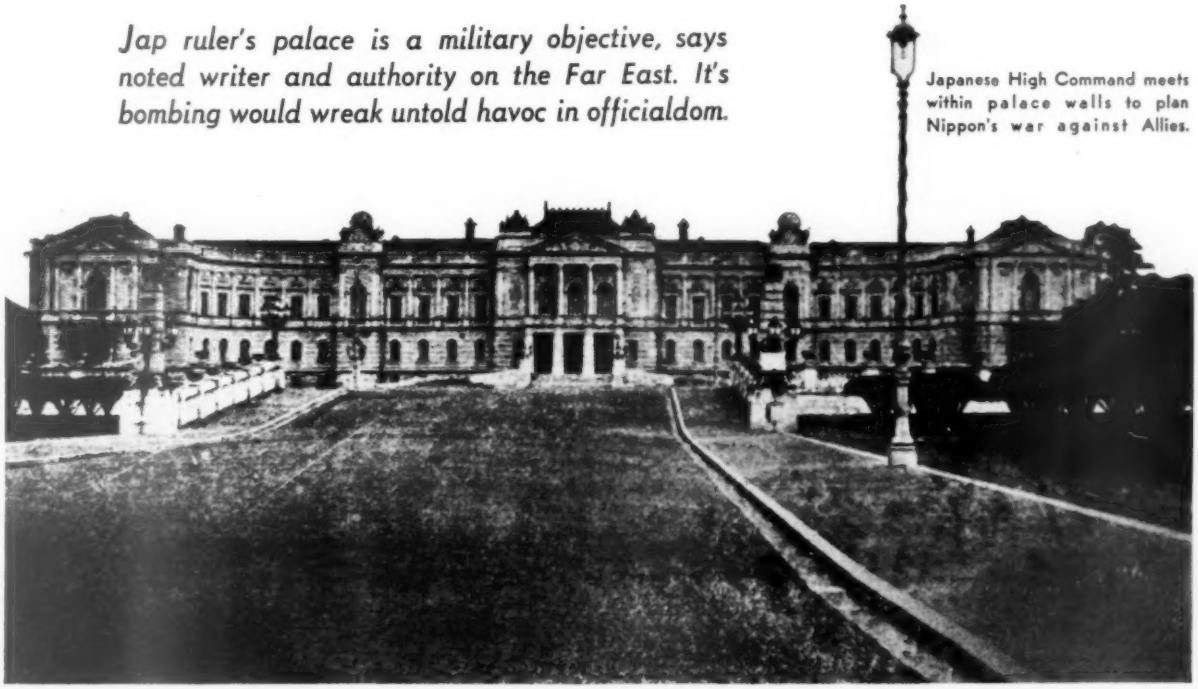
The fact that a high placed general resigned after the first American attack, and that the chief of the defense command was out from loss of face, proves the vulnerability of the imperial system. Others have been thrown into prison.

A close study of the report by Brigadier General Doolittle on the epic flight of his 80 men over Japan—the third attack on Japan since 1937—points up the extreme vulnerability of the Axis empire partner and reveals that the Japs are not the calm, composed people they have been portrayed.

Often it is said the Japanese are a people who can endure floods, earthquakes, typhoons, monsoons, tidal waves,

(*Continued on page* 141)

Jap ruler's palace is a military objective, says noted writer and authority on the Far East. It's bombing would wreak untold havoc in officialdom.



Japanese High Command meets within palace walls to plan Nippon's war against Allies.

TWA's "401," was the first of the 33-passenger, four-engined over-weather transports.

The Stratoliner

by EDWARD CHURCHILL

The pioneer craft of over-weather flying have left the civilian airlanes and are in the Army for the duration.

GONE from the airways for the duration, unless a miracle occurs, are the giant four-motored "307-B's," more popularly known as the *Stratoliners*. Today, these pioneers of over-weather flying for airline passengers wear the dun color of the United States Army Air Forces. Civilian America, given a taste of high flying comfort, again rides in Douglas DC-3's, content in the thought that the *Stratoliners* are doing their job for Uncle Sam in all parts of the world.

In passing, the "307-B's" have left their mark on the domestic skyways. Far-seeing TWA, the airline which co-operated with Douglas to give the nation the first DC-2, has proved the four-motored planes are practical for airline transportation and that they will serve as civilian transports when the war is over.

Proof of what they have done lies in the operations report on NC-1940, carrying TWA's number "401." This plane is one of the five which TWA operated transcontinentally for 19 months, from July 8, 1940, until drafted by the Army Air Forces in January, 1942, only a few weeks after the debacle at Pearl Harbor.

No. 401 and her sister ships showed that supercharged cabins functioned well, making it possible for flights as high as 20,000 feet without discomfort in breathing. Previous to this, 12,000 feet was considered the transport ceiling without oxygen. They demonstrated that over-the-weather flight not only avoided almost all storms but that rough air, the bane of most passengers, was left far below. And too, they proved that cross-

"Stratoliner" operation added a flight engineer (foreground) to usual crew.

continent schedules could be cut to 15 hours, and at the same time made special runs in 11 hours, also showing what could be done in the future. From a standpoint of economy, they revealed that in spite of increased size and therefore increased original cost and operation expense, the actual expenditure per seat-mile was almost exactly that of the commercially successful Douglas sleeper transports.

The original cost of No. 401 was $351,990 as against $118,000 for the DC-3's. With a wingspread of 105 feet and height at the tail equal to that of a seven-story building, it weighed 30,000 pounds empty, carried a crew of five and 33 passengers. The Douglas DC-3, fully loaded, weighs 24,500 pounds, carries a crew of three and 21 passengers on day flights. Carrying a full load, the gross weight of *Stratoliner* "401," is 38,368 pounds.

Experiments which made "401" possible started in 1935, when Jack Frye, president of TWA, asked Boeing for an over-weather plane. Frye knew such a plane was feasible because of experiments in high altitude flying made by D. W. "Tommy" Tomlinson, TWA chief engineer and test pilot over a period of years, under Frye's sponsorship.

No. 401 had a lot of gadgets (which were not to be found on the DC-3, or any other transport plane) in addition to her supercharged cabin, into which air was "packed" to give passengers 8,000 foot comfort at 16,000 feet, and 12,000 foot comfort at 20,000 feet. Among these were the gyro-stabilized compass, an instrument combining the function of an artificial horizon, magnetic steering compass and directional gyro with co-ordinated readings to eliminate the faults of all three; remote transmitting compass, supplementing the gyro-stabilized compass, situated in the extreme rear of the fuselage free from electrical and magnetic disturbances, and flight analyzers which recorded the elevation and radio contacts at any point during flight. And, for the first time, celestial navigation was utilized, making flight off airways possible, with the only limitation being the necessity to refuel every 1,500 to 2,000 miles.

No. 401 with her four 1,100 h.p. motors, hung up a few records for herself. Fully supercharged, they drove her with an assisting tail wind 349.95 m.p.h. from Columbus to New York. The run, 521 miles, was covered in one hour and 49 minutes. She went easily to better than 25,000 feet.

No. 401 was turned over by Boeing to TWA on May 10, 1940. A TWA flight crew took over at Portland, Ore., and flew the big plane to Kansas City via Denver, Colo. For many months a TWA factory inspector and his assistants had watched her go together so that they knew every nook, cranny and gadget, and how everything on board functioned.

At Kansas City, more tests were run. Nearly 100 items designed for passenger comfort were installed. TWA engineers estimate that on "401" and her sisterships, such items weigh 29 pounds per passenger. Being scientifically minded, however, the engineers include the weight of the two stewardesses in this figure. Well, they do aid passenger comfort, do they not? They weigh a total of 260 pounds.

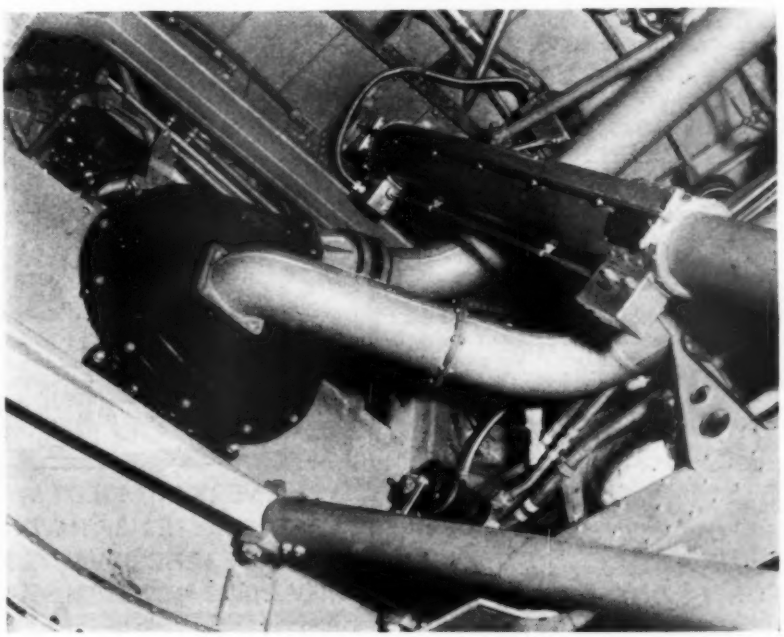
In addition to this, minor operational installations and changes to special TWA equipment were made before the plane was put on scheduled flights.

Once ready to go, "401" and her four sisters were in for some hard work. In 19 months of operation between Burbank, Calif., and LaGuardia Field, N. Y., they ran up the amazing total of 25,125 hours, covering 4,522,500 miles without injury to anyone. They hauled 110,000 passengers, of which "401" carried her share.

From May 10, 1940, until March 9, 1942, "401" flew 5,674:09 hours. This is approximately 3,096 hours per year, 258 hours per month, eight hours per day. These figures prove conclusively that modern transports can keep going day in and day out, spend little time in the shops. No. 401 flew 1,031,320 miles and carried 21,808 passengers during her commercial service.

Flying enthusiasts like to say that you can operate a plane as cheaply as a car. That isn't true when you discuss the costs of putting 4,400 h.p. and more than

"Stratoliners" are equipped with two compressor fans, through which rarefied air at high altitudes is sucked and increased in density before passing into the ventilators.



38,000 pounds into the air. It would be better to compare it with a streamliner or an ocean liner.

For one thing, there's crew cost. By the hour, this comes a trifle high. Your captain, first officer, flight engineer and two stewardesses require an investment of $22.61 for each 60 minutes. With "401" operating 258 hours each month, paychecks run to $5,833 for that period. And for her entire commercial life, we get $128,289, or a little more than one-third of the original cost of the craft!

Four motors drink a lot of gasoline. In flying as far and as high as she did, "401" burned 1,096,784 gallons of gasoline at an average cost of 30 cents per gallon. Set the cash figure at $350,000 and you find that the craft gulped practically her own cost in gasoline. Add

"Stratoliner" crews now are flying the converted airliners on Army cargo work.

24,398 gallons of oil at approximately $1 per gallon—$24,398.

Passengers have to eat—and on the *Stratoliners* they ate food specially prepared by Dave Chasen, Hollywood restaurateur, a favorite of the movie stars. Approximately 27,260 meals were served aboard "401." Figuring $1.46 per meal —Chasen catering comes high—the investment was $39,799. Take Chasen's word for it that he delivered nine and one-half tons of meat and 18,000 gallons of coffee to "401." If the 21,808 passengers had drunk all the coffee they wouldn't have slept very well, but you have to figure that TWA always has "more than enough" and that pilots and crew are coffee lovers, too.

As an advertising gesture, TWA sent out commemorative silver lucky pieces the size of a half-dollar to the first few thousand *stratoliner* riders. They were great souvenirs. This evidently had a salutary effect on the customers, who did little pilfering. The loss in silverware on "401" was very small, as no insignia is on it. Same goes for towels. But TWA encourages the "lifting" of salt and pepper shakers. This good will venture, on "401," cost the company $920.

Twenty-five mechanics comprised the ground crews which kept each DC-3 in

(*Continued on page* 82)

Flying Safety in the Army

by Capt. GEORGE C. PRICE

Executive, Directorate of Flying Safety, AAF

Army pilots are being taught to save their daring for use against enemy, not waste it in foolhardy stunting.

YOU can't kill a Jap from an ambulance! That fairly obvious statement, appropriately and graphically illustrated, adorns one of the new posters that will help impress on all Army airmen that common sense safety measures are just as necessary to a fighting pilot as the itch to catch a Zero in his gunsights.

It seems so elementary that anything as complicated, sensitive, speedy and roaring with power as an airplane should be handled with a due amount of respectful caution that the idea of a large-scale campaign just to insist that airmen be careful may appear to be continuing an argument that's already settled.

But it isn't. People still get killed driving automobiles into places they don't belong, remember, and it's all too easy for a young fellow who has learned to do a lot with a plane to get the confident notion that he can do everything with it. Maybe he can do almost as much as he thinks he can. Maybe, in a pinch, he can do more than he had any idea he could do. But he doesn't have to prove it every time he takes a plane off the ground.

Not that anybody wants our pilots to lack daring—quite the contrary. Daring, courage and a complete disregard for personal danger are all to the good in the proper place. One of the prime purposes of the flying safety program, however, is to impress on the minds of the adventurous youngsters in the Army Air Forces that the proper place is in combat with the enemy, not stunting out of pure exhilaration over some Iowa cornfield, or showing off half-a-thousand feet above the girl friend's home.

"Youngsters" are mentioned advisedly, because all the records show that not only are the vast majority of flying accidents caused by human rather than mechanical failure, but most of the human failures can be laid to lack of experience. However, no one in the entire organization of the Air Forces is overlooked in the safety program, and a three-star general can be disciplined just as promptly as a cadet for infraction of the safety regulations.

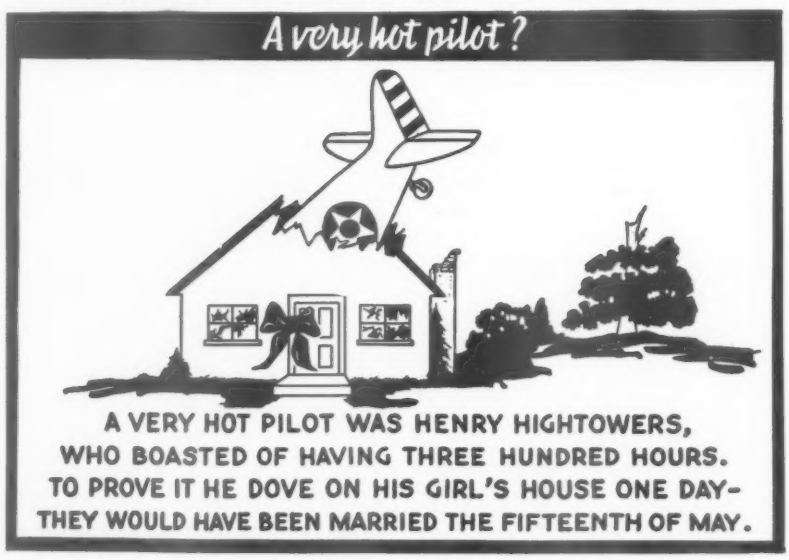
Back of the creation of the new Flying Safety Organization in April lie the record of the Army Air Forces as the safest military flying organization in the world, and a determination to maintain that record despite the vast expansion of the Air Forces and the consequent influx of inexperienced personnel.

The highest accident rate in the history of the Air Forces since the last war was recorded in 1922. After that year, the rate dropped steadily and quickly to an amazing low just before the threat of war led to expansion of the air arm to undreamed-of size. And despite the increase in the number of accidents, the accident *rate* still is 68 per cent below the 1930 level, and 10 per cent lower than the 1930-1940 average. That is a matter of pride in an organization whose safety achievements are a proud tradition.

It is pride, however, that permits no complacency in the face of a single accident. A plane damaged or destroyed

(*Continued on page* 114)

The Army Air Forces series of cartoons on flying safety are terse and to the point.


A very hot pilot?
A VERY HOT PILOT WAS HENRY HIGHTOWERS,
WHO BOASTED OF HAVING THREE HUNDRED HOURS.
TO PROVE IT HE DOVE ON HIS GIRL'S HOUSE ONE DAY-
THEY WOULD HAVE BEEN MARRIED THE FIFTEENTH OF MAY.

Miss Iverson and Eugene Damrow check equipment and maps prior to Alaskan flight in 65 h.p. Taylorcraft.

ALASKA ADVENTURE

by CAROLINE IVERSON

Careful planning and adherence to the advice given them by experienced bush flyers brought these able lightplane pilots safely through a hazardous trip.

IT takes more than good flying to reach Alaska. It takes an infallible engine and luck. Unless you have both, don't try the trip in a lightplane.

We knew we were fortunate to have made the trip safely several months before the World War struck the U. S. at Pearl Harbor. Just how fortunate, even we didn't guess till a letter arrived from Inspector Burleigh Putnam, Jr., in charge of general inspection for the CAA in Alaska.

Putnam wrote:

"It was the first year that light ships have made the trip . . . of the six privately owned airplanes flown up here for pleasure this summer, yours was the only one to make the trip a success from the standpoint of an accident."

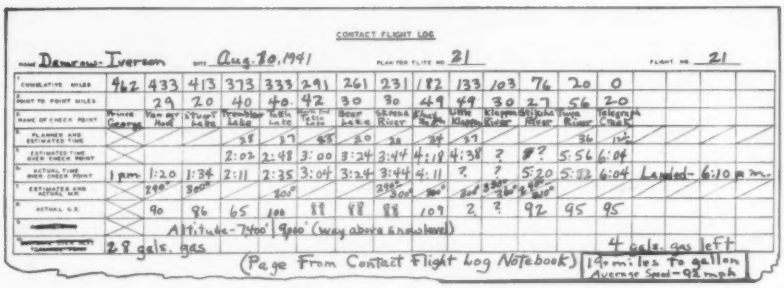
So now we (Eugene Damrow, Fond du Lac, Wis., and Caroline Iverson, Wauwatosa, Wis.) give the 65 h.p. Continental engine in the nose of Gene's 1941 Taylorcraft an extra-loving pat each time we fly, especially as we remember the 450-mile hop from Prince George to Telegraph Creek where we couldn't have sat down without cracking up. There was nothing but breath-taking snow-capped mountains, rivers that either cut deep gorges out of solid rock or were flanked by narrow swamps, and blue, deep cold-looking lakes on that route.

We also thank the pilots, radiomen, and meteorologists of Pan American for the hints they gave us.

One hint: "Wait for a break in the weather and then scoot fast!"

Second hint: "Listen to advice."

That's the way everyone flies through western Canada and Alaska. The weather is generally unfavorable. As for the advice, you not only talk to people who've *flown* the course before. When they aren't available, you consult those who know it from a boat trip, dog-sledding, hunting, prospecting or a pack-horse trip. Then you use your head, your eyes and your compass, check with the best map you can buy, and you'll get there—with luck!



CONTACT FLIGHT LOG

Name Dameron-Iverson Date Aug. 10, 1941 Plan for Flight No 21 Flight No 21

Cumulative Miles	462	433	413	373	333	293	261	231	182	133	103	76	20	0				
Point to Point Miles		29	20	40	40	42	30	30	49	49	30	27	56	20				
Name of Check Point	Prince George	Van der Hoof	Stuart Lake	Trembler Lake	Mt. Milo	Fort Fraser	Bear Lake	Skeena River	Kluatantan	Little Kluatantan	Kluatantan River	Stikine River	Iskut River	Telegraph Creek				
Planned and Estimated Time				38	37	65	30	28	39	39			36	112				
Estimated Time over Check Point				2:02	2:48	3:00	3:24	3:44	4:18	4:38	?	?	5:56	6:08				
Actual Time over Check Point	1 pm	1:20	1:34	2:11	2:35	3:04	3:24	3:44	4:11	?	?	5:20	5:52	6:04	Landed- 6:10 p.m.			
Estimated and Actual Hdg.		290°	300°		300°			295° 300°	300°	300°	320° 320°							
Actual G.S.		90	96	65	100	89	88	88	109	2	?	92	95	95				
		Altitude- 7400' 9000' (way above & no level)																
Gasoline used this leg	28 gals. gas														4 gals. gas left			

(Page From Contact Flight Log Notebook) 19 miles to gallon Average Speed-92 mph

Page from flight log shows Taylorcraft averaged 19 miles per gallon at 92 m.p.h.

We started north from Seattle. Original plans to follow the coastline to Juneau, Alaska (it seemed a simple short trip as we studied it in Wisconsin) were thwarted when we found that there were no refueling stops for a landplane.

On the inland course through British Columbia our biggest hop between gas stops would be only 262 miles . . . Vancouver, east to Hope; north to Williams Lake, Prince George, Fort St. John, and Fort Nelson; northwest to Watson Lake, Whitehorse, Dawson and Fairbanks, Alaska.

Once we had our course, what a hurry and scurry there was at Boeing field, Seattle, as we made final preparations. There officials advised departure just as fast as we could make it.

"The weather will be perfect for two or three days. It's almost unbelievable for British Columbia and Alaska. You don't want to delay."

We bought maps, checked with customs and immigration officials, stocked up with emergency rations required by the Canadian government, including hardtack, canned butter, powdered milk, nuts, a slab of bacon, fishing equipment and a rifle. We had the plane, engine and radio thoroughly checked by a mechanic. We spent a session very painstakingly going over maps, discussing landmarks, weather, airports, etc., and received the blessing of CAA Supervisor R. D. Bedinger of the seventh district. Last, we abandoned our big wardrobe case for a tiny overnight case that held a dress for me, a clean shirt for Gene, and little else.

Two days after we had landed at Seattle from the east, we wired home to our folks in Wisconsin:

"We're off to Alaska!"

And to Vancouver customs and immigration men:

"We'll see you in two hours."

The weather was truly glorious. It was fortunate, too. Even the airlines do not fly in western Canada except in contact weather, in spite of their complete instrument equipment. Just riding along, you have the thrill of a lifetime seeing endless forests of green pines marching up the mountains to the timberline, then barren rock. Farther north mountains are crested with perpetual snow and glistening glaciers. There are large jeweled lakes that vary in color as much as the tiny hot-spring pools of Yellowstone. Of course it's gold country, ivory country and the land of wild moose, caribou and mountain sheep. Everywhere beauty in rough nature that can only be seen from the air.

However, amidst all the beauty, a pilot wonders where he'll land in an emergency. There is no place on the whole route except the few landing fields specifically created for the airlines. There's not a town, a road, railroad, or human being evident for 500-mile stretches. No wonder contact flight rules only are observed!

We found Prince George easily by following the Fraser River from Vancouver. There our worries began.

Watson Lake airport, one of our next stops, we discovered was "under construction." (That really shouldn't have bothered us—every airport in the United States between Milwaukee and Seattle also had one runway or more "under construction"!) However, this airport was just being started. We wired to Watson Lake for last minute information.

The answer read, "If you wire two hours in advance of your arrival, we'll get out the grader and smooth off a little spot for you."

Nonetheless, our "advisers" still felt we should avoid that field, and rather make the long hop to Telegraph Creek . . . 450 miles. That's the hop we'll never forget.

Normally, our cruising range was 375 miles. We'd have to carry extra gas and devise a way for getting it into the main tank from the cabin while in flight to go those 450 miles.

Gene, an aeronautical engineer and a Ford garage man figured it out. They welded two handles on a little wobble pump from a Ford V-8 motor and rigged up gas cans with special copper tubing inserts in the caps. A tiny hole was cut in the windshield of the plane for a tube to go through to the cover of our main gas tank. Rubber tubing connected this to the outlet of the wobble pump.

In flight we felt like a couple of sardines packed tight. We stored a four-gallon can of gasoline in the luggage sling beside the small suitcase, put two one-gallon cans on the floor under our legs, one in front of the radio and one on the little ledge at the back. These cans held Imperial gallons, one quart larger than U. S. gallons. The wobble pump was on the seat between us, easy to use by either pilot or navigator.

Despite the load, the plane took off and climbed perfectly. Rising to 7,000 feet and heading northwest, we soon spotted our first check point, Stuart Lake.

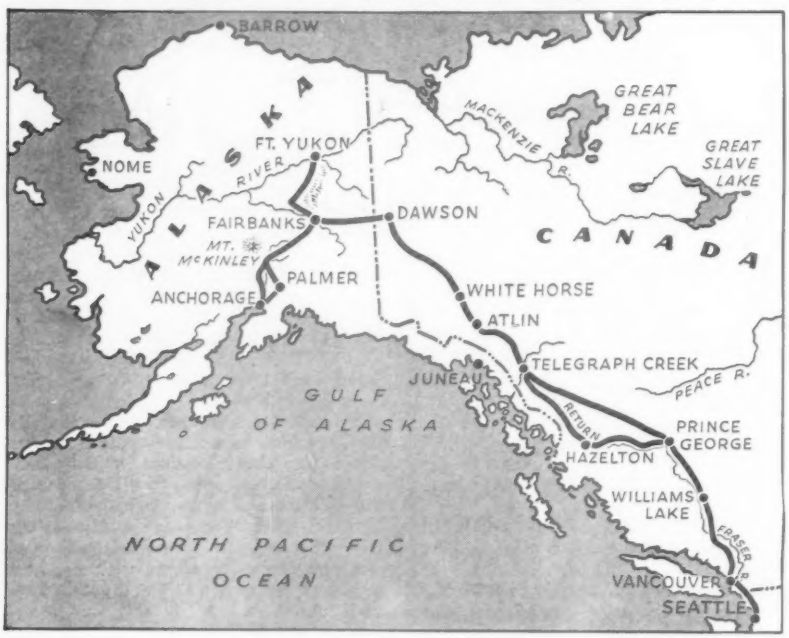
For our navigating, we had drawn a straight line on the map between Prince George and Telegraph Creek, and measured the true course as 320°. We had to subtract 30° for magnetic variation . . . luckily we had been told about that. (It wasn't on the map.)

Then with the aid of pilots in Prince George we studied our map for waterways along the straight line course or intersecting it to mark as check points. When the course was devoid of them, we altered it to follow a river or lake.

We had a set of the contact flight logs used in the CPT cross-country course. By measuring the distance between the check points to fill in this log in ad-

(*Continued on page* 115)

Map of British Columbia and Alaska, showing route of Alaska trip. Flyers averaged 79 m.p.h. ground speed for entire flight of 8,876 miles over a period of 31 days.



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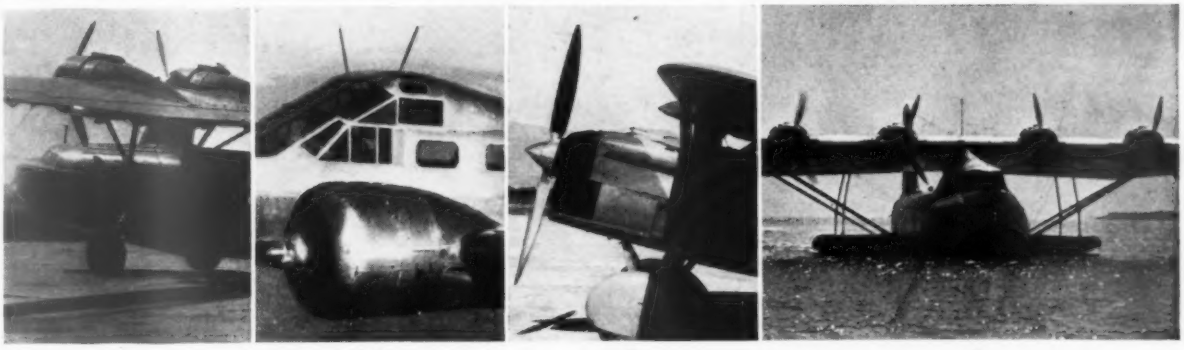

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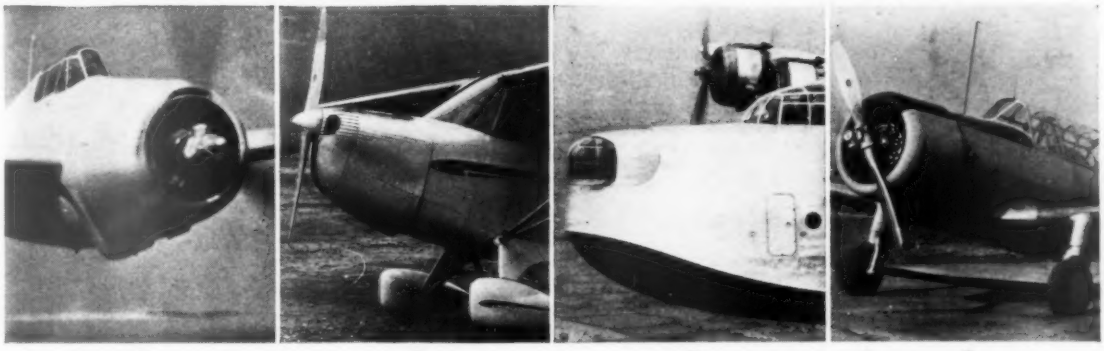

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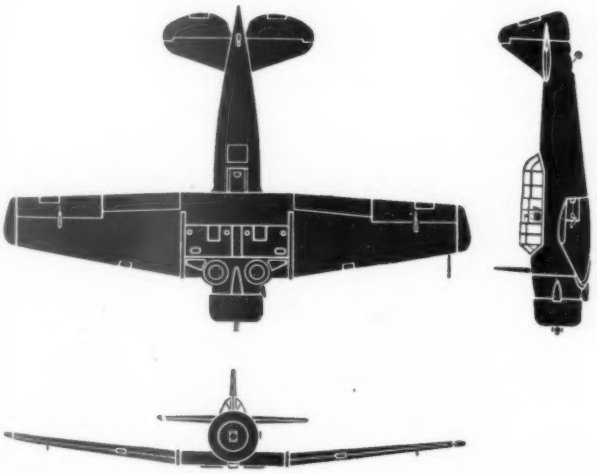
The planes are: 1. Sikorsky S-43 (JRS). 2. Beechcraft JRB-2. 3. Piper "Cub Coupe." 4. Short "Sunderland." 5. Grumman "Wildcat" (F4F). 6. Fairchild PT-19 "Cornell." 7. Fairchild PT-23 "Clipper." 8. Vultee BT-13.

NORTH AMERICAN AT-6A

Advanced Trainer

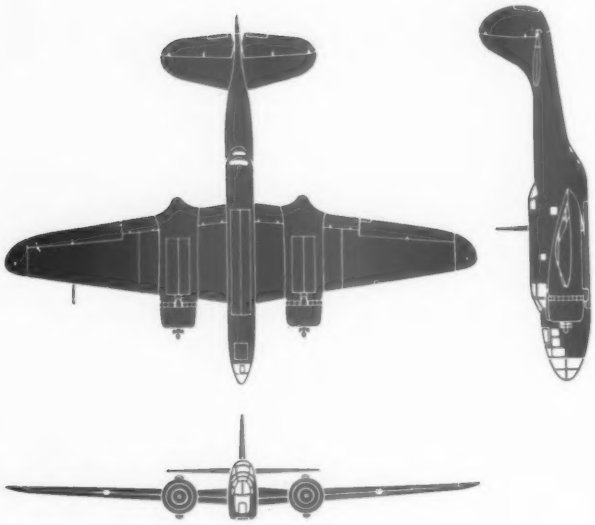


PERTINENT FACTS: One of the most widely used trainers in its class in the world, the AT-6A bears that designation in the U.S. Army, is standard in the U.S. Navy as the SNJ and is well-known in the Royal Canadian Air Force as the *Harvard II*. In appearance the AT-6A follows the same general plan as its equally well-known sister ships, the North American BT-9 (NJ in the Navy), BT-14 and BC-1A. Powered with a 550 h.p. air-cooled engine, the AT-6A has a top speed of 206 m.p.h. and cruises at 180. Normal range is 730 miles. Gross weight is 5,248 lbs. Wing span is 42 ft. ¼ in., length is 28 ft. 11⅞ in. and height 11 ft. 8¼ in.

WHAT TO LOOK FOR: The wing follows the North American practice on most of its trainers. It is cantilever, has moderate dihedral from the center section outward and has the characteristic sharp leading edge taper and almost straight trailing edge. The tips are rounded but blunt. Note that the center section has no dihedral. In contrast to the straight lines of the wing, the horizontal fin and elevator are well-rounded. In the side view, the large "greenhouse" juts up from the fuselage. The tail surfaces form almost a perfect triangle; the sharply-tapered rudder is quickly noted. The landing gear retracts directly inward from the wing roots, folding flush into the center section just forward of the cockpit. The tail wheel does not retract.

MARTIN A-30

Medium Bomber



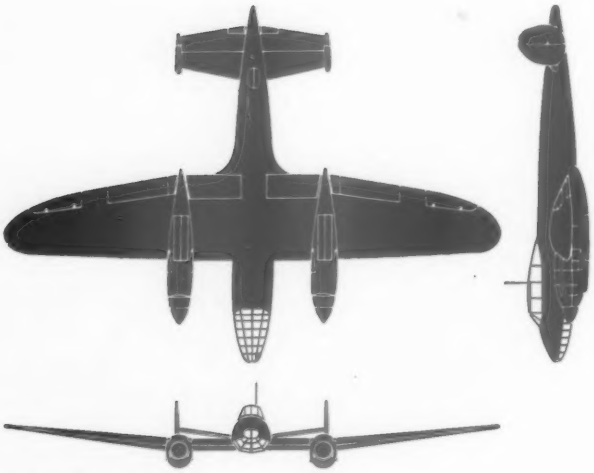
PERTINENT FACTS: Originally designed for the Royal Air Force under the designation *Baltimore*, this aircraft has since been taken over by the U.S. Army Air Forces as the A-30 (Attack, Model No. 30). Already in wide use in the Libyan desert, the A-30 is one of the most heavily-armed aircraft of its type in the world. It has a number of fixed guns as well as a power-driven rear turret. As a matter of fact, the British *Baltimore* has proved particularly valuable as a fighter. Powered with two 1,600 h.p. Wright engines, the A-30 has a top speed in the 300-m.p.h. class. Wing span is approximately 65 ft., length 58 ft. and height 19 ft. Somewhat lighter than the Army's Martin *Martian* (B-26), the A-30 (Martin's factory model No. 187) is big brother to the *Maryland*, smaller Martin veteran of RAF campaigns in Africa.

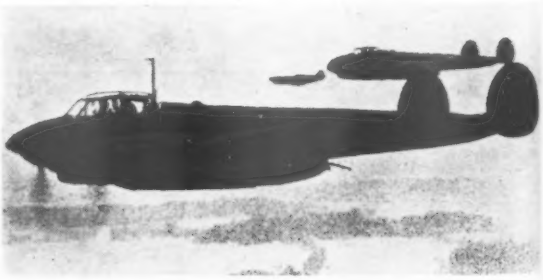
WHAT TO LOOK FOR: A cantilever mid-wing monoplane, the A-30 is a conventional twin-engined aircraft, but has numerous readily identifiable features. When seen from below, the wing has equal leading and trailing edge taper, with rounded tips. The shape of the engine nacelles protruding from the trailing edge are peculiar to this airplane. The tail is full cantilever, having conventional rounded surfaces. The fuselage is quite narrow and deep, tapering off rather sharply from the gun turret to the rear, having a very thin appearance at the tail in comparison with the rest of the fuselage.

FLYING, December, 1942.

RUSSIAN PE-2

Light Bomber





PERTINENT FACTS: One of the most widely used light bombers in the Russian air force, the PE-2 is a high-speed, low-wing monoplane carrying a crew of three. The engines are the 1,300 h.p., V-type, liquid-cooled M-38, developed from a design of the famed Russian designer, A. N. Toupolev. Top speed is slightly over 300 m.p.h.; bomb load is from 1,700 to 2,000 pounds.

WHAT TO LOOK FOR: In the side view, the PE-2 looks very much like an aerial shark, the "teeth" consisting of the transparent lower section of the nose in which the bombardier lies prone. The wing is of conventional design, being fully cantilever. Wing panels, attached to the rectangular center section, have trailing edge taper to the rounded tips; the leading edge tapers only slightly. There is marked dihedral from the center section out. The engines project far forward of the wing; the nacelles project only slightly from the trailing edge. Note particularly the twin-ruddered tail and the dihedral in the horizontal fin and elevator. The landing gear is conventional and fully retractable, including the tail wheel. Note that this ship is equipped with both flaps and dive brakes.

FLYING, December, 1942.

FOCKE-WULF Fw-190

Fighter

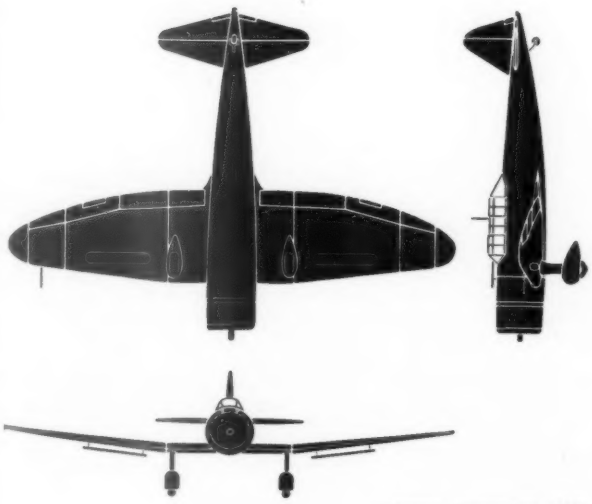
PERTINENT FACTS: Germany's latest—and probably best—fighter is this low-wing single-seater which has been shot down in large numbers by U. S. Army B-17's over France. Powered with a 1,700 h.p. air-cooled B.M.W. radial engine, the Fw-190 has a top speed of 375 m.p.h. at 18,000 ft. According to the engine data card in the cockpit of a captured Fw-190, the ship climbs 3,050 f.p.m. at 4,000 ft. and 3,280 f.p.m. at 17,500 ft. Gross weight is 8,580 lbs.; wing loading is 42.3 lbs. per sq. ft. Armament is four 20 mm. cannon and two 7.92 mm. machine guns.

WHAT TO LOOK FOR: In appearance, the Fw-190 follows many a time-honored American pattern. Using a powerful radial engine for the first time on a modern German fighter, the Fw-190 might be mistaken for an American type in flight. Its low, cantilever wing has slight dihedral and moderate taper in leading and trailing edges. Tips are square cut and rounded on the corners. The engine forms the widest part of the fuselage; the controllable propeller carries a large spinner. The tail surfaces are conventional and cantilever. The cockpit hood is fully transparent, giving the pilot good all-around vision. A sheet of armor plate is installed behind the pilot's head. The unusually wide-tread landing gear retracts inward flush into the fuselage and center section. The tail wheel is partially retractable.

FLYING, December, 1942

AICHI 99

Dive Bomber



No Photograph Available

PERTINENT FACTS: First used against the U. S. at Pearl Harbor, this Jap dive bomber still is in use by the Jap navy and is carrier-based. Specifications and drawings from which our silhouette of this aircraft was made were obtained from U. S. Navy sources; the data were compiled from shot-down 99's in Hawaii. The engine is a 1,050 h.p. air-cooled Kinsei MK-44, giving the ship a top speed of 245 m.p.h. at 13,000 ft. At 205 m.p.h., the range is 874 miles. Ceiling is 30,000 ft. It carries 206 gallons of fuel. Span is 48 ft., length 36.5 ft. Wing area is 389 sq. ft. Normal crew is two. Armament is two 7.7 mm. fixed machine guns in the fuselage firing forward and one 7.7 mm. flexible gun in the rear cockpit. Bomb load is 550 lbs.

WHAT TO LOOK FOR: From the center section outward, the wing is elliptical in shape and has marked dihedral. Tips are rounded. The cantilever tail surfaces have sharp taper. The cockpit enclosure follows standard practice. Landing gear and tail wheel are fixed. To be looked for are the externally mounted dive brakes seen on the underside of each wing. In a dive, the pilot can turn them so their flat surface is presented to the wind. This is a device copied from the Germans.

FLYING, December, 1942

Next Stop: TOKYO

Student navigators at Mather Field receive instructions for their final test flight—a simulated mission to the enemy capital. Panel (left) shows practice hop over water.

by M. H. CARRINGTON

Success of our bombing missions depends on accuracy of navigation. The Army is training men to lead its crack pilots and bombardiers to vital enemy centers.

MOST familiar sights in America today are U. S. Army Air Forces pilot training schools. Spotted all over the land their planes are in the air day and night.

Practically unknown, in comparison, are three new schools which have been added to the vast training program. The first of this "secret trio" stretching over many acres of an historic field of World War I, is at Mather Field, on the outskirts of Sacramento, Calif. (The others are located in Texas and Georgia.)

It is a navigation school, unit of the far-flung West Coast Air Forces Training Center, and the final test given to graduating students is a simulated bombing flight to Tokyo!

The first view of Mather Field is a thriller in itself. Flanking long lines of blacked-out barracks and laboratories are endless rows of heavily guarded twin-motored "flying classrooms" in which the students work out navigational problems at 180 m.p.h. The sight of the endless rows of planes is particularly exciting, for the total is more than the former Air Corps was able to mobilize for the "mass strength" maneuvers at this field in 1930.

Col. Leland R. Hewitt, the commanding officer (18 months combat flying in France in World War I and on the job in military aviation since) explains the purpose of the school:

"We train navigators for the stream of multi-motored warplanes pouring off the production lines in ever increasing numbers.

"To be of value to the war effort, these planes must reach their objectives—but to be of the greatest value they must return home safely—which brings the navigator into the picture as a key man.

"Our prized bombsight, in the hands of an ace bombardier, cannot score hits until navigated to the target area. It is the navigator's responsibility to guide the plane to the target and back to its base under blacked-out conditions in which he may not receive outside aid other than reference to the stars, and sometimes not even that."

Sounds like a four-year college course, but this unique institution, taking raw cadets with little or no knowledge of the subject, accomplishes a miracle of train-

ing in 15 weeks! What's more, the graduates regard an error of one mile in 100 as "just fair" navigating. A *Flying Fortress* could make up that error in a few seconds of flying.

The daily program gets off to an early start with long lines of brisk-stepping cadets marching to class. Other long lines, carrying neat rolls of charts and brief cases heavy with mysterious tables, instruments and pencils sharpened to needle-point, are marching to the flying field for air missions.

A visit to any Army Air Forces training school these days is immensely encouraging, but the sight of these lads—trim youths from 18 to 26 years of age—skyrockets the patriotic emotions to a new high. For them the future holds no promise of glamor or glory. While they will share equal responsibility with the pilot and bombardier in carrying out missions, it is a thousand to one bet the only one the public will hear about is the pilot.

Lieut. Tom Garrett, ex-New York school teacher and now flight commander of one of the training echelons, supplies details of the school's operation:

The students are regular Army aviation cadets who were selected in "screening" tests as "navigator material." Aptitude for mathematics is one of the prime qualifications.

In the 15-week course they master four methods of navigation: celestial, radio, dead reckoning and pilotage (visual reference to landmarks). When they graduate they are capable of maintaining one-mile-in-100 accuracy, or better, at speeds up to 400 m.p.h. Compare this with the boat navigator who works at a leisurely pace of perhaps 35 m.p.h.

Item No. 1 in the opening lesson sounds the keynote of the whole course. Simple, to the point and stripped of all confusing technical terms, it defines navigation as "the science of getting from one point to another, accurately and efficiently, despite the weather and the topography of the land."

The course covers 387 hours of ground school instruction, 56 hours of meteorology and 96 hours of day and night flight missions which take the students on off-airway hops as far as 2,000 miles from home. Instructors explain the many hours of meteorology thusly:

"Tokyo won't supply weather information."

This meteorological knowledge is put to use on flight missions in analyzing the conditions ahead to determine whether to continue on the course, to attempt to go around, over or under the weather or to turn back. Decisions are made after conference with the chief pilot, with whom the navigator holds equal rank aboard plane. Also holding equal rank aboard is the bombardier.

Navigating is a full-time job and the navigator is not required to do any of the piloting so no flying instruction is included in the course of training. However, many of the student-navigators have had piloting experience in civilian life.

The students learn the value of split-second accuracy on missions in which a

Student (above) working dead reckoning problem sights ground objects in drift meter to determine true course. Men below don heavy clothing for work at higher altitudes. Twin-engined Beechcraft AT-7's were especially designed for training of navigators.

number of planes, coming from different directions, converge on an objective simultaneously, a new war development which screens the full force of an attack from ground observation until it is actually unleashed on the target. Arriving a minute early might tip off the enemy and bring the whole mission to disaster. A minute late will lessen the force of the attack.

They learn to work out interception courses on missions in which they are required to intercept boats at sea, other planes, or ground troops on the march, in the shortest possible time. In this they must carefully watch the fuel range of their plane and accurately determine the radius of action under the existing weather conditions. The only information they receive is the approximate speed and direction of the enemy. When they have laid out their interception course and are flying it, they must be prepared to change it at a moment's notice should the enemy strike off at a tangent, speed up or do an about-face.

They navigate their planes on long distance searches, in which they must cover every foot of a given area as if seeking an enemy submarine or invasion force.

These and all other missions are treated as real war problems, with life or death hanging on the results of their work. As a matter of fact, a great many of their missions, especially those of interception, are based on actual war problems received from our own flyers in the Far East and from RAF crews conducting long range bombing raids on Europe. A number of the missions from this west coast school take the students over the Pacific Ocean. Others take them far inland, across high mountain ranges and sparsely inhabited country that provides the ideal blacked-out war landscape for simulated night bombing missions.

The number of books they use is surprisingly small, considering the depth they go into the subject. Among the principal volumes are a restricted RAF publication on astronomical navigation tables recently released to U. S. Army schools; tables of computed altitude and azimuth, a Government hydrographic publication, the American Air Almanac; a textbook on celestial navigation and another on air navigation.

The work kit for air missions is an exact duplicate of that used by graduate navigators now on combat duty with the Air Forces. It consists of the books of astronomical tables, sextant, dividers, plotters, computer, charts, handful of needle-pointed pencils, forms for recording readings, scratch paper for working out mathematical problems and notes to pilots, and, of course, the plane's built-in navigation equipment, drift-sight, compasses, etc.

They must learn the shapes and positions of the planets and at least 35 guiding stars so they can locate them instantly under adverse sky conditions. They must master the sextant, the octant, all types of compasses and scores of instruments and devices, including one they call a "confuser." Officially, it is a computer.

(*Continued on page* 128)

All Pastures Aren't Airports

by

R. W. F.

SCHMIDT

R. W. F. "Bob" Schmidt, born in Ames, Ia., and now claiming Nevada as his home state, has been engaged in airport site selection, planning and construction since 1929, when he began as field engineer for Curtiss-Wright at Glenview, Ill., and at points in California, Michigan and Ohio. His subsequent work with the old Bureau of Air Commerce, United Air Lines and the CAA has taken him into more than 30 states. He now is acting superintendent, Airport Service, CAA, Region VI, Santa Monica, Calif.—Ed.

THE private flyer is admittedly being pushed around these days. Many of the older fellows are moving from the airports back to the pastures, and many of the youngsters haven't been away from the pastures. But they are taking it gracefully, fully realizing that Uncle Sam and the boys with the PT-s, P-s and B-s need the fields and the airspace.

The rapid acceleration in military training, testing, defense and export manufacturing and ferrying has necessitated that scores of heretofore civil airports be completely closed to private flying. Normal expansion in civil aviation, increased private and commercial activity occasioned by national defense, and other stimuli including the CPTP have, however, provided private flying with an impetus which cannot be waved aside.

R. W. F. "Bob" Schmidt.

True, scores of major airports are being improved and a number of wholly new airports are being built by several means—notably the current CAA airport development program—and in a few metropolitan areas secondary fields are being constructed for use by the private flyer. In general, however, the facilities being developed today are not available to the rank and file of private flying because of demands imposed by national defense, and others will not become available because of heavy scheduled air carrier operation. When the emergency conditions now existent no longer require drastic restrictions, however, many fine landing areas will then be open to private flying. However, the pushing around is forcing the selection of new airport sites which are being developed with private capital and in some cases with city, county or even state funds, at points where Federal assistance is not possible at the present time for any of several sound reasons. For example, Federal expenditures must now necessarily be used to develop airports for larger and faster equipment in strategic areas as defense measures, whereas the requirements of private flying are normally satisfied by the establishment of less elaborate airport facilities.

The responsibility for airport site selection in many communities has rested with private flyers whose objective has been to locate, acquire and construct a facility for *their own immediate use.* And this point, frankly speaking, is where untold trouble arises all too frequently. In the rush to establish a new landing field or to refurbish an old one, the careful, calculating analysis of all factors is often conspicuous by its absence.

Here it is not amiss to point out that each of the regional offices of the CAA has a staff of experienced airport engineers available for consultation in site selection and airport planning. Many private flyers are not aware of this service, and many of those who do know about it are reluctant to request assistance because of the small size of the project or because they believe the absence of Federal funds does not encourage Federal interest. These CAA men are extremely busy, but you will find them anxious to be of all possible help, irrespective of the backing of a given development, because each established airport definitely affects the permanent system of facilities and aids to air commerce.

An apparently insignificant one- or two-hangar field established today may well become of major importance in its trade area tomorrow. Past experience has demonstrated that site selection is always worthy of serious deliberation even though the immediate objective appears

(*Continued on page* 126)

Women Flyers of America, organized in 1940, made it possible for business girls to acquire wings.

WINGS for the Working Girl

by JULIETTA K. ARTHUR

Although ready to do any work to aid the war effort, girl flyers welcome their new opportunity to serve the Army as ferry pilots.

ON the hottest night in the summer of 1940, nearly 500 girls—pretty debutantes, actresses in and out of work, teachers on vacation, models and clerks—crowded into the Hotel Plaza in New York. On the flag-draped platform in the swanky ballroom an ex-theater manager was talking about a new organization. The Women Flyers of America, he said, would put girls in the air on a pay-as-you-go (plus down payment) basis. Wide-eyed stenographers heard how they could save lunch money, have flying lessons every day before sundown and take their vacations soloing at one of New York's many airports.

Today the ex-theater manager has vanished into the limbo—or wherever non-flying ex-theater managers go—and the actresses and models and socialites have for the most part dribbled away. What is left is a determined group of over seven hundred student flyers, a handful of experienced women pilots to guide and encourage them and 10 chapters in as many cities. The membership ranges from 17 earnest school teachers in Lincoln, Neb., to the possessors of the luxurious clubhouse in Miami, Fla., donated by fellow-member Annette Gipson.

Enthusiasm rose to a pitch after Pearl Harbor. Hundreds of girls signed up for flying lessons, most of them filing applications for the Civil Air Patrol; Emily Chapin, Board member, is already flying in England.

All of the members would like to fly; they quote glibly what their sisters are doing in Britain, and point to the recent formation here of training and air ferrying units for women under the Army Air Forces Ferry Command. But they are also willing to set up files, check records, and as working girls, give Saturdays and Sundays to those airports taking part in the CAP program.

Restrictions on cross-country flying haven't squelched these girls, either. "If we can't fly 10 miles, then we'll do three." they say. Gone are the fashionable blue corduroy uniforms which bloomed in the spring that first year. Gone is the down-payment clause, too. But the reduced rate at Government-approved fields for the flying course still holds good. And the pay-as-you-go method tempts the $20 a week stenographer as well as the housewife-on-a-budget.

For a year Katherine D. Lynch, super-

visor employed by the New York Board of Education, flew every day (before school) at Rockaway Beach airport. Before she joined the Women Flyers of America, she had never even been a passenger in a plane. But she used her vacation to finish logging some 300 hours. Now she not only holds her commercial pilot's license, but was an instructor in the Women's Flyers' New York ground school, and has served as the organization's national secretary.

It's girls like Kay Lynch who've put the Women Flyers on the aerial map, and women like the managing director, Mrs. Herbert Roth (Vita Shoemaker, U.S. women's parachute jumping record holder, to you) who've kept them there.

Whether anybody likes it or not, there's a big body of young women in this country who are going into aviation via the Women Flyers of America, if not by the front door, then at the back.

For when the Government withdrew its civilian pilot training program from the college girls who leaped into prominence when they took it, members of the Women Flyers didn't care. Most of them were working girls on a "nine to five" basis, anyway. Their flying instruction came, weather permitting, after work and on week-ends. You could have seen them in New York, for example, piling into a battered station wagon drawn up before the Hotel Plaza, or rumbling out in a second-hand car to the seaplane base at Skyharbor or to the airports at Rockaway or Nassau or Roosevelt Field.

Then national headquarters capped its experience by landing a parachute rigging job for one of its members, which bids fair to put a group of airminded girls in the Navy.

Down at the Pioneer Parachute Company in Manchester, Conn., Floyd Smith remembers when he folded parachutes for Vita Shoemaker, out in Illinois. That was when she was the slim, 90-pound Polish-born girl who was piling up 263 jumps, with the aim of climbing out of a plane to better the world women's parachute jumping record. Finally she did it, way back in 1930, at 19,800 feet. That record hasn't been beaten yet in the United States.

Mr. Smith learned that the Women Flyers of America had elected Vita Shoemaker Roth as their head. Then he heard that with her help the Women Flyers of America had launched the first class in the United States to teach girls to fold parachutes. Rigging is hard work requiring a healthy body, but not necessarily a large or muscular one. "The average proficient woman rigger," says Mr. Smith, with authority, "often weighs but 105 pounds." Gladys Freeman was the first member to get a job. She's at the Quonset, R. I., Naval Station. Every girl who took the course has had similar offers—and the Navy promises to take all the women riggers the women flyers can graduate.

Three nights a week, down in an emptied cafeteria in the Wall Street district (put at their disposal by then-national secretary Jessie O'Connell), a class of girls pioneered. Later another group,

(*Continued on page* 136)

Ice Indicator

by SIGRID ARNE

The complicated science of electronics solves a serious winter flying problem. Detection of ice on any part of plane is done automatically.

THERE'S a little gadget which has just been perfected in Minneapolis that likely will make this winter's flying easier for the boys who pilot American bombers.

It's an ice-indicator. It isn't impressive-looking. It weighs about five pounds and looks like a handful of telephone cord connecting two small black boxes, a dial and a plastic disc.

It does three things:

1. It tells when ice starts to form on the plane.
2. It tells how thick the ice is.
3. It can switch on a de-icer.

In short, it means the bomber pilot has one less thing to worry about. It sounds simple. But actually the young scientist who invented the gadget, Dr. Waldo Kliever, put the complicated new science of electronics to work to make it. Besides, it's the first time anyone has been able to measure the rate at which ice forms on a plane.

Until now, the co-pilot has had to do the worrying and trust his own judgment. If you've ridden a sleeper plane, you've seen him at night come back into the cabin and throw his flashlight beam along the leading edge of the wing. He was looking for ice and trying to determine how thick it was.

There already is a means of getting rid of ice, once it's discovered. It's the de-icer, sometimes called a "rubber boot." You may have noticed it—that strip of black along the front edge of a plane wing. It's rubber. Under it are air vents. When ice forms, air is blown up through the vents, up under the rubber. The air pulsates the rubber, and the pulsating breaks up the coat of ice, which just blows off in flakes.

But the plane makers always have wanted some mechanical way to signal the beginning of ice.

Kliever's indicator went through tests all last winter and does the job to his satisfaction. And to the Army's.

The indicator starts with a small disc set into any surface of the plane which wants watching. This disc is linked to a dial on the pilot's dash board. When ice forms, the dial's needle swings to the right, and as it swings it indicates just how much ice is outside on the wing.

It isn't a gadget that measures dropping temperature like a thermometer. It doesn't touch the ice. It simply registers "ice" because the ice changes the character of the electrical "field" around it. The job to find such a gadget started when the National Advisory Committee for Aeronautics asked Karl Larson of Northwest Airlines for help, because his company flies planes on schedule through the northwest's tough winters.

(*Continued on page* 147)

Novel device overcomes winter flying hazard by revealing when ice starts to form and thickness of coating. It then automatically turns on the airplane's de-icer.

THE FALLACY OF DISPERSION

by
CY CALDWELL

Concentration of Allied force is the only practical means of crushing the Nazis by invasion and destruction of war plants.

☆ ☆ ☆

THE United States war effort resembles the strategy of the Irishman who mounted his horse and charged off in all directions. We are going everywhere, and so far getting nowhere. After nine months' dispersal of our efforts, Lieut. Gen. Brehon B. Somervell, U. S. Army, summed up the situation: "We are losing the war."

If we are to win it, we must stop our dispersion sometime and concentrate for the offensive, somewhere. But not everywhere.

To a great extent this dispersion has been unavoidable. We entered a war being fought in Europe, Asia, Africa, in the Atlantic, the Pacific, the Mediterranean. Undoubtedly there are sound military reasons for every move we have made. But sound or unsound, we are on the defensive everywhere, on the offensive nowhere. And there is not an instance in history where defense has won a war.

Our war strategy bears a disquieting resemblance to that of Great Britain, which in three years of war has not won a campaign anywhere on land except in Africa against the Italians, admittedly push-overs even for the small and poorly equipped Greek army. And the fruits of the Libyan campaign were subsequently snatched from the British by less than 10 per cent of the German army.

Dispersion of British forces would have been inevitable in any event, for the British held positions all over the world and they had to be garrisoned. But to this unavoidable dispersal they added others, Norway, Belgium, Greece, Eritrea and Ethiopia. It was part of a plan to be everywhere. We, too, must be everywhere.

The loss of Singapore and Crete resulted less from dispersal, as such, than it did from an utter failure to realize in advance the necessity for strong air forces to support ground and naval forces.

Crete and Singapore, like the Philippines, the Netherlands Indies and Burma, have proven conclusively that spreading ground and sea forces around the world without strong air forces to assist them is merely to invite defeat. But spreading all three forces, land, sea and air, means only that the nation's available war power may be spread too thinly everywhere to be effective for victory anywhere.

We cannot rest content with the excuse that necessity forces us to supply Russia, Britain, China, India and Australia with war material, and to send what amount to "token forces" of Americans everywhere on the globe where a ship may dock in friendly territory. This necessity, after all, has been supplied by the enemy. Therefore his is the initiative, and we are merely following a pattern that he has laid out for us. But if we are to be guided only by a policy of dispersal, we will never gain anywhere.

Many have believed and hoped that a second land front would be opened in Europe this year. The sending of large forces of Americans, mostly ground troops, to Ireland and England had indicated the practical certainty that a land front is to be opened. But if that action is to wait until the Russians are defeated and Hitler can shuttle a large part of his eastern armies and air forces across Europe, it might better not be attempted. Whether such invasion action is initiated now or next spring, one result is certain: a tremendous destruction of shipping, which must strain still further our long lines of sea communication all over the world. If invasion is tried and fails, the loss will not be confined to that campaign, but will have world-wide repercussions.

Invasion of the continent, even now when the Germans are preoccupied with the Russians, is a costly and hazardous venture whose outcome no general staff can predict. The magnificent defense of the Russians this year and the tremendous losses of the attackers have emphasized anew the appalling cost in men and material of direct attacks on positions fortified in depth and defended by resolute men.

Further evidence of the price of invasion was offered by the Dieppe raid, which cost 170 dead, 633 wounded, and 2,547 missing out of a force of 5,000. If study of this raid and of the Russian-German campaign dictates a spirit of caution that delays the opening of a second front until next Spring, then we face another winter of waiting and preparation, on the defensive, while the German army continues unhampered its wearing down of the Russians. We will be in the humiliating position of leaving the war in Europe to the Russians, that in Africa to the English, while we shuttle more troops across the Atlantic and continue to peck away at the Japs in the Pacific.

Even if our objective is (as the Russians have been assured) to open up a land front in Europe, we haven't supplied the airpower adequately to support it. Judging by our raids so far, we have sent across only a small air force, a few squadrons of *Flying Fortresses*. Apparently we are leaving the air war to the English. That is understandable when we reflect that all decisions about our air policy are made by the General Staff, which thinks in terms of armies first, with air forces to support them.

While our air officers may advise and suggest, they do not hold supreme command in the realm of grand strategy. Quite obviously the last thing in American high command thinking is the use of airpower alone to knock out Germany. Yet it is the one force we can use at this time to deliver blows to the heart of that nation; and the only force we can use until the moment when we open up a front on land. If German defensive works along the French coast seem too formidable to attack until some time next year, we should at once open up a real hard-hitting air front; a huge joint British-American offensive.

RAF raids of the past summer show that entire cities can be practically knocked out by bombing, and that great industrial plants, such as the Renault works in Paris, can be completely destroyed. The Germans admitted that

(*Continued on page* 118)

Taught machine shop work by actual operation and production, students quickly find places as semi-skilled aero mechanics.

The NYA in Aviation

by CHARLES T. MALONE

The National Youth Administration is doing an invaluable job by providing work for youth and workers for our wartime industries.

IN many workshops throughout the country the National Youth Administration is offering young people between the ages of 17 and 24 years the type of work experience aircraft manufacturers want—practical on-the-job training. The NYA workshops are miniature factories where the youthful trainee uses the same tools and techniques employed elsewhere on a larger scale. Turret lathes, milling machines and drill presses are not mysteries to NYA trainees, because they use them every day. Other trainees specialize in welding, riveting and sheet metal working—each art indispensable in the manufacture of aircraft. The NYA form of training is not theory taught from textbooks, but is imparted by the actual operation of machines.

Few realize the full extent of the contribution which the National Youth Administration, under the direction of Aubrey Williams, himself a veteran of the last war, has made and now is making toward the preservation of American independence. Already thousands of NYA trained youth are at work in such well-known airplane plants as Consolidated Aircraft, Vultee, Glenn L. Martin Company, Boeing, Douglas and others, and additional thousands will take their places in these and other plants as production foremen and personnel managers ascertain the extent and value of the basic training they have received. Well grounded in basic skills and adapted to factory conditions, NYA trained youth are ready. As the tempo of aircraft production increases, airplane manufacturers can rely more and more on the NYA for experienced young workers.

Every NYA shop has one or more competent supervisors, each of whom acts as a combination instructor and shop foreman. These experienced men operate

their shops as up-to-date factories are operated, and each keeps a careful check on the youths working under his supervision.

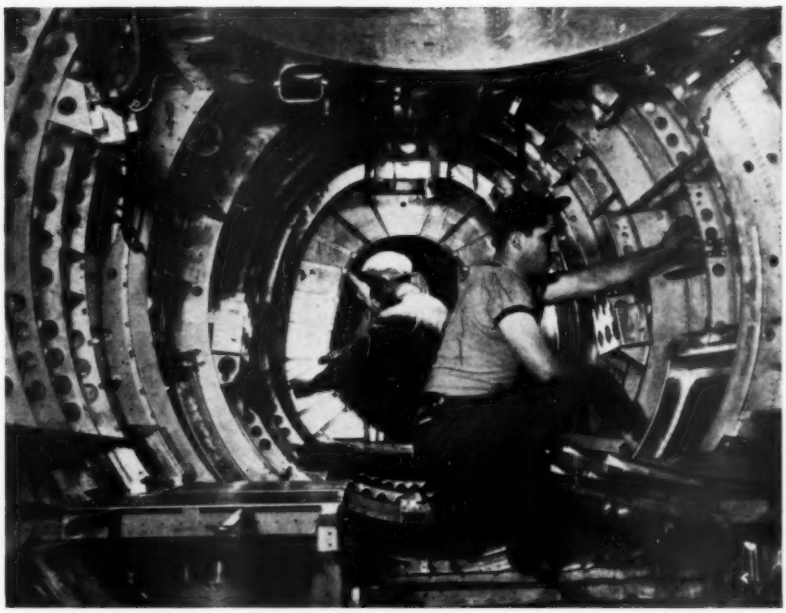
In addition to the shops referred to, the NYA has many resident work experience centers, wherein are located various types of shops. The Dayton, O., aviation work experience center, for example, employs eligible young men from Ohio for the new NYA-Army Air Forces Work Center at the Fairfield Air Depot in Dayton, where they receive pre-employment training and experience on NYA projects sponsored by the Army Air Forces.

Each worker at the center, which accommodates 360 young men, is assigned to six months work in either engine, instrument or plane repair; machine, propeller or parachute shopwork; or woodwork. These youths live at the Miami, O., work experience resident center; they earn NYA salaries ($30 per month, less subsistence expense). Although employment by the Army Air Forces is not guaranteed for all youth who gain work experience in the center, the Air Forces does make appointments from the NYA group to the position of mechanic-learner at the regular Civil Service rate. One month's satisfactory work as a mechanic-learner qualifies the learner for a position as mechanic-helper. Other classifications in the civil service also will be open to him.

The Dayton center, one of a number of similar work experience centers operated by the NYA in co-operation with the Army Air Forces, serves a number of useful purposes. It provides workers for the increasingly important maintenance and servicing of Army aircraft; it assembles civil service registrants for preappointment work similar to that for which they are waiting, in order to determine their fitness for the service; and the Army is assured of getting men who have been checked locally by NYA personnel officers, interviewed carefully and tested in preliminary work on NYA assignments. Operation of these centers is handled entirely by the NYA, but workers are under the supervision of, and responsible to, Air Forces mechanics.

The experience gained in these work centers fits youth for employment in airplane and glider factories as well as for Air Forces employment, and the training program is geared to meet the demands of many other war material industries as well as that of the aircraft industry. In the month of September, 1942, more than 65,000 young people were employed in NYA workshops scattered from Maine to Texas and from Florida to Puget Sound. Many of the workers are rural youths who never before had the opportunity of developing their latent engineering and industrial skills. These youth, attracted from the farms by high industrial wages, have an ingrained common sense and native ingenuity not common to urban youth and make excellent engineers, designers, mechanics and airplane pilots.

As an example of the facilities used in the average work center let us take a look at the South Charleston, W. Va., training center for aircraft workers. Here are six shop divisions, including welding and sheet metal, all electrically operated. The shops are fully tooled and have adequate inventories of materials and supplies. Standard makes of tools are used. Equipment includes a rivet furnace, fabric sewing and doping equipment similar to that used in the large airplane factories, valve seating sets, spot-welders, power presses, grooving machines and the commoner shop equipment. The young men learning to use these machines are, at the same time, actually producing defense materiel—including gun parts, dies, stamped metal parts, bolts and nuts, hand tools, etc., and in some shops complete training gliders are being built by NYA personnel.



Trained by the NYA, these men at the Glenn L. Martin plant at Baltimore, Md., are drilling and installing vital control wires inside the fuselage of a B-26 bomber.

The development of proper work habits is basic to NYA training. It is important because it means that the boys can be put on a job at once. In a period when personnel and machinery cannot be spared for training purposes, it is vital that new employees know how to act in factories, how to repair and keep machines operating, how to avoid wasting materials and how to get along with their fellow workers. Because they actually have worked under factory conditions, NYA trainees need no additional training. This is of great benefit to industry and has helped speed the production of vitally needed war materiel by transferring from industry to NYA the slow, expensive and tedious job of breaking in personnel.

At aircraft plants NYA youth are put on the job at once as helpers or semi-skilled workmen; further evidence of the value of such training.

Due to the increasing tempo of aircraft manufacture, and the fact that women perform certain tasks more quickly and accurately than men, women now are being used in increasing numbers in the aircraft industry. Keeping pace with the increased demand for trained women aircraft workers, the NYA increased its training program for young women in industrial operation 400 per cent during the last six months of 1941. The training in workshops is concentrated on the type of work for which these young women are best suited, namely, inspection, assembly and light machine work. Some of the California aircraft plants also use young women as welders, riveters and detail assemblers.

Due to the concentration of industry, and the migration of skilled and unskilled workers, the NYA has established residence centers which serve as clearance centers for NYA trainees from a different state.

The Army recently requested NYA officials to increase accommodations at the Dayton, O., experience center threefold, so as to train 1,000 men simultaneously. The limit previously had been 360.

At Nepaug, Conn., for example, there is a resident center which draws NYA-trained youth from other centers located in rural areas in Connecticut and nearby states. Here they are given specialized training in preparation for the specific requirements of industry located in the Hartford area, where a shortage of skilled and unskilled labor was created by the activity of war industries. Major Maloney, director of the Connecticut State Employment Office, in commenting upon NYA activity in this respect, said: "I think this is very, very important, not only to our state, but to other states which will reach this same stage in their labor supply."

Every day and in many different ways, the National Youth Administration finds ways and means to benefit youth, enabling them also to contribute toward na-

tional wealth. During the past year more than 425,000 NYA enrollees obtained jobs in private industry as a result of their NYA training. The majority went into vital war industries such as aircraft, shipbuilding, ammunition and the manufacture of machine tools. Boys of the Texas NYA, for example, being trained for industrial work contributed to the nation's defense while learning their respective jobs. A recent announcement stated that Texas boys employed by the defense shops produced 65,000 essential articles for the U. S. Army during the last three months of 1941. These articles ranged from gun racks to fluorescent lamp fixtures. Among the articles made were iron map display racks, military skids, intercommunication sets, machine gun dials, sighting devices for antitank guns, 81 mm. mortar aids, sheet metal air vents, gun sighting angles, sheet metal megaphones, gun sighting bars and targets, metal signs, Army lockers, holders for automatic machine guns, office desks, public address systems, etc.

The farsightedness of NYA officials is illustrated by the fact that the Cassidy Lake, Mich., resident work center was busily engaged in building gliders long before most people knew what gliders were, or realized their great usefulness in preliminary pilot training. In the summer of 1941, *The Spirit of Youth II*, first all-metal glider to be built by a Governmental agency, was brought to Washington from the Cassidy Lake project to be demonstrated to Government officials, including Army and Navy officers. This glider, built under the supervision of Theodore Bellak, NYA's glider pilot, made many flights in the neighborhood of Washington, D. C., carrying as passengers many well-known congressmen, including the junior senator from West Virginia, Dr. Joseph Rosier, and Army and Navy officials. Senator Rosier acted as chairman of a subcommittee of the Senate Committee on Education and Labor which later held hearings on a National Youth Glider Pilot Training Act.

Since the success of the Cassidy Lake glider project several other state NYA glider projects have been started, including those in California, Washington, Illinois, Minnesota, Maine, New Hampshire and Wisconsin. If the National Youth Glider Pilot Training Act (S. 1749) is passed, the NYA will be authorized to build training gliders by the thousands, thus training hundreds of thousands of our youth by giving them aircraft work experience while producing something of great value. The Act also provides that the NYA may establish immense glider pilot camps to teach hundreds of thousands of boys and girls to fly gliders, thus creating a huge reservoir of potential airplane pilots for war or peacetime.

END

Modern Scrolls

THE ancient scroll has been adapted by American Airlines, Inc., into an efficient instrument for recording data on test flights. Use of the scroll idea avoids losing pages or getting them out of their proper order.

FROM HEADQUARTERS

by Lieut. Col. HAROLD E. HARTNEY (A. F. Res.)

Harold E. Hartney

WASHINGTON has been extremely busy lately. Some of the work done has been gratifying, some of the criticism uncalled for and disturbing.

Kaiser got a contract all right. It is difficult to say whether it was given just to get rid of him or whether is was to get real cargo planes under way. On the morning when the contract was definite, I telephoned the person in the Government agency largely responsible for getting help for Kaiser. I congratulated him and then found to my amazement that there was no definiteness on the prototype to be built. Venturing to suggest what time and experience has so impressed on the minds of those who know, I pleaded that those who are skilled in operations of aircraft should have a hand in the design and recommended the Air Transport Command of the Army. This did not fit because the intention is to build boats. Feeling that, by the same line of reasoning, the prototype should have the advice of a flying boat man of long experience, I recommended, by name, an engineer who would have the unanimous approval of all of my readers. He was not interested because he feels that the future of large aircraft lies in land planes not boats. His conviction is verified in the fact that his company now operates land planes over the oceans.

So I again called up my friend who had helped Kaiser and suggested that he build one landplane and one boat. His boss, the aviation "expert," frowned on this and vetoed it with the remark, "landplanes and flying boats cannot be constructed by the same engineering concern!"—this despite the record of Consolidated, Boeing and Glenn Martin.

So it goes down here! Eighteen million for Kaiser is small potatoes nowadays, but, oh, flying boats are so easy to shoot down, so hard to get off in rough seas, so hard to dock and maintain in these days,—when a Piper *Cub* could pack a cannon and with a 20 mm. 10 ounce projectile properly placed do as much damage to a mammoth airplane as a torpedo to a battleship!

* * *

Disturbing, too, has been all this chatter about our planes not being as good as those of our enemy. The Luftwaffe is winning this war with the bulk of its equipment obsolescent. Junkers Ju-52's, Ju-88's and the Stukas are still in quantity production.

Give me a 1918 Sopwith *Camel*, a 200 h.p. Waco (or a trainer of any kind that is highly maneuverable) and a camera gun; I will hang on my prop and let any Messerschmitt, *Spitfire* or Focke-Wulf make his sweeps at me with his camera gun. When the films are developed, I will have a *dozen* pictures of him to every *one* he has of me.

But this is not original. Such a demonstration was put on by Udet in Germany two months before he was killed. He did it to combat agitation going on within the Luftwaffe which was tending to kill morale in their pilots, just as now it will squelch the spirit of our boys on the front if they get the idea that our planes are no good.

In the Spanish-American War, there was a song, "It's the man behind the gun that does the work!" Someone in this world conflict should bring out a song, "It's the pilot behind the stick that shoots 'em down!"

If anything, our planes are too good. They are so strong that our bombers have already put up single-handed fights against as many as 40 Focke-Wulfs and flown home, riddled but ready to fight another day. One can imagine how Pilot Paine (Lieut. Charles Paine, Waycross, Ga.) danced on those old rudders and tugged at the stick as he frantically threw his *Flying Fortress* about against 40 German fighters, his gunners now and then getting in a good burst. Ask Dr. G. W. Lewis of our National Advisory Committee for Aeronautics the "g's" he put into that bomber and find out what would have happened to even the ultra-modern *Lancaster* had Paine been flying the British bomber instead!

* * *

History is repeating itself again. In the last war, our boys in the First Pursuit Group took over a batch of Nieuport 28's. Neither the French nor the British wanted them because of a weak leading edge which imbedded in the fuselage a sneaky little bugaboo bigger than any of our critics has planted today in our planes. Later (September, 1918) that outfit got the Spad XIII; it had an engine that threw carburetors, rocker arms, cylinders and magnetos when it got mad at the prop. Props did have a bad habit of getting knicked on the take-off in those days and so (from vibration) the engine got nasty very often. Capt. René Fonck's *Stork Escadrille* could not figure out how the Yanks kept 60 per cent of their planes serviceable when they could have but 20 per cent ready for action each morning.

But good old American morale frowned on such stuff, and, without even parachutes to add confidence, our pilots piled in and within 30 days officially shot down 111 Germans with the loss of but eight men and planes. Compare that with the official record given out by the Sub-Committee of the Military Affairs Committee of the House of Congress recently

(*Continued on page* 120)

AIR CARGO PROBLEMS

by
R. D. KELLY
and
W. W. DAVIES

Putting wings on freight cars will not provide cargo planes. The air freighter must be a precisely engineered aircraft stressing speed, safety and efficiency.

Excess air express can be carried in passenger cabin. Canvas protects seats.

W. W. Davies

Eminently qualified in any discussion concerning the engineering problems to be overcome in the formation of an air cargo system, R. D. Kelly and W. W. Davies go beyond the mere question of providing huge aerial freighters. Their experience as research engineers at United Air Lines has afforded them the opportunity of ascertaining with slide-rule precision the less known designing and operating problems to be overcome in a well planned and successful air freight development. Mr. Kelly majored in mechanical engineering at Purdue University, graduating with a B.S.M.E. Mr. Davies received his mechanical engineering degree from Armour Inst. of Technology.

R. D. Kelly

THE subject of air cargo, present and future, has been receiving generous treatment in newspapers and periodicals throughout the world. Everyone agrees that air cargo is tremendously important to the whole war program; also, that it stands to be a stellar performer in post-war days.

Much has been said about present and future cargo planes. As yet, however, there has been little discussion about the small but vitally important details having to do with actual cargo handling. It would seem that this subject deserves immediate attention, for certainly much of the success of air cargo operation will depend on the solution of engineering and mechanical problems having to do with more than the general design of air freighters.

It is our purpose not only to indicate probable design and performance trends but also to outline some specific problems of carrying air cargo. The background for the conclusions drawn is based upon: first, an actual research study for cargo airplane performance and design criteria; second, present airline cargo handling experience, from which it is apparent that present methods and equipment are wholly inadequate for any great extension; and third, opinion and imagination.

At the outset, it is desired to emphasize one very important fact. An airplane only progresses towards its destination when it is in flight. Therefore, all ground time during scheduled operation is lost time, and every effort must be made to keep this to an absolute minimum. For instance, on the existing non-stop schedule from Chicago to New York, every minute of delay in getting into the air must be compensated for by an increase of one m.p.h. in flight speed. Converted into horsepower, this means 11 h.p. more for the entire trip in a Douglas DC-3 airplane for each minute delay.

Using this same type of illustration for a transcontinental cargo trip, we assume a scheduled 2,600 miles in 13 hours, or an average speed of 200 m.p.h. Let us assume eight stops enroute, which is certainly not excessive for a cargo flight. If an average of 20 minutes ground time is required for each stop, then the average flight speed the airplane must make good to maintain schedule will be:

$$\frac{2600}{13-\frac{(8\times 20)}{60}} = 252 \text{ m.p.h.}$$

If the ground time can be cut in half, to 10 minutes, then the equation becomes:

$$\frac{2600}{13-\frac{(8\times 10)}{60}} = 223 \text{ m.p.h.}$$

This demonstrates a difference of 29 m.p.h. Where else can effective improvement of 29 m.p.h. be gained so easily or cheaply as by improving ground handling methods and efficient cargo storage in the airplane?

Probably many designers and operators think that even a 20-minute average ground time stop for fueling and cargo transfer is fairly good—and so it is, for present thinking methods. But, are they willing to sacrifice so much speed and economy to a competitor who has the equipment and methods to get his ship in and out in 10 minutes? Every minute gained in reducing the ground time works throughout the whole trip. Further, the reduction in congestion due to fewer airplanes being on the ground at one time is of major importance also.

The railroads realize the importance of short stops. Recently one of the authors had an opportunity to ride in the cab of one of the latest streamlined locomotives. The major surprise came at a division point when, even with a crew change, the time between the stop and start was less than two minutes. Passengers, mail,

express and baggage were all easily handled within this time.

Another important point to be stressed is the absolute need for good schedule reliability for air cargo operation. Many proposals for cargo airplanes have made the assumption that air cargo could wait for favorable weather, and that schedule reliability and safety were not of primary importance. Further, that vibration, noise, lack of heating and ventilation, etc., could be tolerated if weight and cost of airplane could be reduced thereby. It is the opinion of the authors that this attitude is incorrect, and that future designs should be based on a schedule of reliability, safety, and general operation closely approximating that of the purely passenger transport operation. Most of the reasons for this thinking will be developed later, but at this time it may be well to bring out one or two important factors. If schedule reliability is not maintained, it will be impossible to make close connections with other air carriers and time thus wasted will overcome many of the advantages of shipment by air. In almost every case where material is sent by air, a premium is paid for that service because time is important and a certain deadline is to be made. Without a schedule reliability as good or better than that of the passenger transport, the customer is gambling upon the arrival time of his shipment at its destination. This does not promote the maximum use of air cargo.

To attain schedule reliability it is necessary that cargo airplanes be equipped with all the facilities needed for operation under adverse conditions. They must be provided with anti-icing equipment and a full complement of radio and instruments. The fact that a greater number of landings will be scheduled on a given route by the air cargo airplane will mean that it will usually need to be operated with greater efficiency and precision than the through trip whose primary function will be to carry passengers and mail long distances with few stops.

Cargo airplanes, making frequent stops, provide a logical means for transportation of passengers for short distances, or to the major cities where they can be transferred to through flights.

Basically, the performance and general external appearance of a cargo airplane will not differ from any similar sized passenger transport. Both types of airplanes must do the same job, i.e., carry a given load over a given distance in a certain time. The primary requirements for any airplane are defined by speed, payload and trip length or lengths.

The payload requirements of the cargo airplane are defined by the existing cargo market, which will establish the size of the plane depending upon the frequency of schedule. Schedules may have to be operated frequently to suit the demand, thus calling for a greater number of small airplanes or, when demand will permit for the holding over of certain cargo, a smaller number of large airplanes may be used.

It is generally accepted that speed is of major importance for transportation of passengers. It is the opinion of the au-

(*Continued on page* 103)

Lubricate Lightplanes CAREFULLY

by JACK MORNINGSTAR

Assistant Service Manager, Aeronca Aircraft Corp.

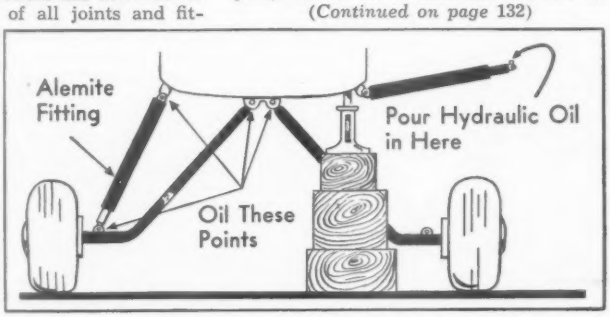
Keeping the engine well oiled is standard practice, but few pilots realize that many other parts require oiling.

ACCORDING to the CAA, there are more than 25,000 privately owned airplanes in the United States. They flew approximately 319,675,000 miles in 1941, using almost 3,168,000 quarts of oil. Many of these airplane owners, like a lot of the people who drive automobiles today, know very little about the necessity of proper lubrication. Few realize that there are many moving parts other than the motor that require frequent oiling and greasing.

Here at Aeronca it has been found that the life of an airplane can be prolonged by careful and thorough lubrication of all moving parts, especially those employing soft bearings. A time limit of approximately 100 hours has been set for a thorough check of all joints and fittings, and repacking of all ailerons, elevators, and all the moving parts connected with the controls.

Reducing friction in all of its forms is the prime factor in achieving efficiency. This is stressed in an attempt to impress on the minds of all airmen the value of lubrication. Lubricants form a thin film on which snugly fitted parts glide, eliminating friction and thus reducing wear to a minimum. Protecting parts from undue wear never will be more important than at the present time, with the great demand of our war efforts requiring complete facilities of almost every plant. It is almost impossible for the private owner to obtain replacement of parts, damaged or worn beyond further use, without a priority. The value of using a good quality oil that is absolutely free of any foreign matter cannot be stressed too greatly. No. 3 cup grease is considered suitable for most grease jobs, No. 20 oil is most suitable for all

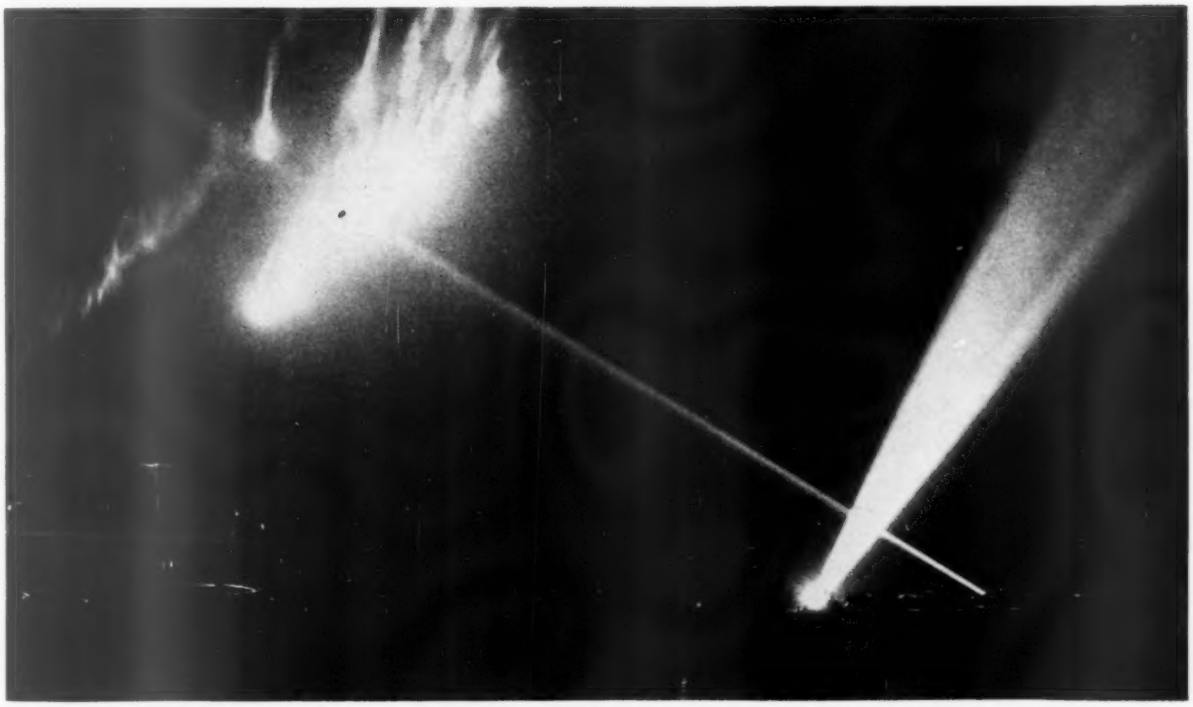
(*Continued on page* 132)



The oleo landing gear should be lubricated with especial care.

T. H. "Doc" Kinkade (center, back of prop), aviation lubricant expert, explains proper methods of engine lubrication to members of Aeronca's service department.

THE NIGHT BOMBER vs. ANTIAIRCRAFT



Searchlights scour the sky to spot enemy plane. Bright flash is flare dropped from bomber to light target.

Wing Commander Cheshire, although still in his early twenties, is the commanding officer of a Halifax squadron in the RAF. He has taken part in many raids on Italy and throughout Germany, including Berlin. He received the D.S.O. in 1940, for flying his burning bomber back to his field after a raid on Cologne. In 1941, he was awarded the D.F.C. for his long and distinguished record in Bomber Command. He is the author of "Bombing Pilot," a book now being readied for immediate publication in England.

by Wing Comm.
G. L. CHESHIRE

Evasion of antiaircraft defenses is a cold, calculating science with the lives of pilot and crew depending on outwitting the foe.

WHEN the night bomber challenges the antiaircraft defenses, he fights a duel in the same way as the soldier or the sailor. But it is a duel in which the quantities are strange and probably unparalleled in history. To win he needs to have tactical and technical knowledge, courage and skill in his basic trade—in this case, flying. That holds good in the army and navy too, but it is the atmosphere in which he fights that is strange. With war are associated hatred and emotional disorder: the soldier can temporarily forget fear in his desire to kill or in a fit of rage. The bomber pilot cannot. He sits on a plane wholly isolated from that on which his adversaries sit. He never sees them, and he has not even the power to harm them. If he feels any emotion at all, it is fear. Otherwise he is cold and calculating, like a fish.

He is calculating, because the evasion of antiaircraft defenses is in a sense a science, not a matter of pushing out your jaw and ploughing through. It is a science in which there are four basic components or rules. First, it takes time to predict an aircraft's position, its speed and its course, to work out where it will be when the shell bursts, to communicate that knowledge to the gunners and for the shell to arrive at the required point. The time is appreciably shorter in daylight than at night time, because visual prediction is simpler than blind prediction. Secondly and consequently, if the aircraft does not fly straight and level for more than that minimum required

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This $16,000 model of a "Stratoliner" was used in wind tunnel tests of the "over-weather" airliner design.

Flying at 50,000 Feet

by RICHARD C. MOLLOY

A powerful cabin supercharging system is the answer to the physiological problems encountered in high-altitude operations.

SO you think it would be fun to take your plane up to 50,000 feet? What a thrill it would be to see the highest cirrus clouds thousands of feet below. And how blue, almost black, the sky would appear. No clouds, no changing weather, some wind, but not too much—and all the sky room you could possibly want. Although such freedom stimulates the imagination, there are many problems to be solved before such altitudes are attainable.

We know the military services have their worries—consisting, for instance, of balancing increased armament requirements against reduced speed at altitude and lower ceiling and vice versa. But let us forego a discussion of these difficulties by confining our attention to the non-military side of the picture. Let us assume that we are interested in a moderately-sized private airplane, capable of flying at 200 m.p.h. at 50,000 feet. With this assumption in mind, let us examine the problems involved.

Figure 1 illustrates the altitude problem pictorially. As the altitude increases, the air pressure falls off toward zero as shown on the left side of the figure. There also is an accompanying decrease in temperature, as shown in the drawing at the right. The center temperature line is an average, based on a rate of decrease of temperature with altitude of 3.57° F. for every 1,000 feet, which has been set up as a standard by the National Advisory Committee for Aeronautics. This standard assumes that a constant temperature of —67° F. is reached at 35,300 feet. Although this arbitrary altitude is assumed to be the tropopause, or division between the troposphere below and the stratosphere above, the actual tropopause may vary from this by several thousand feet.

Maximum and minimum temperatures for altitudes between 10,000 and 50,000 feet are also given in Figure 1. You will

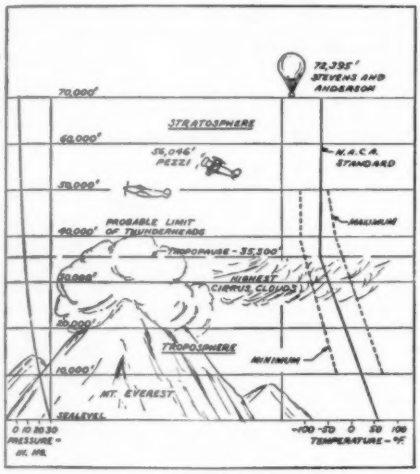


Figure 1.
Meteorological altitude illustration.

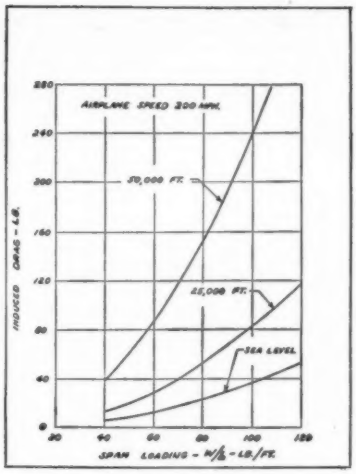


Figure 2.
A typical variation of induced drag.

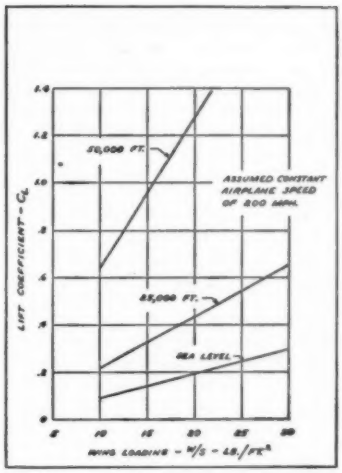


Figure 3.
Effect of wing loading and altitude.

note that at 50,000 feet the minimum temperature is —110° F. while the maximum temperature is about —50° F. This indicates that even on a "warm" day it is unbearably cold up there.

As to cloud conditions in the stratosphere, it is very doubtful whether clouds would be encountered more than a few times a year above 35,000 feet. These clouds would generally be of the cirrus type, composed of ice crystals and commonly referred to as "mares' tails." Occasional thunderheads might reach above 40,000 feet. Comm. Daniel Webb "Tommy" Tomlinson, formerly of TWA, in his "overweather" Northrop *Gamma* discovered in a flight made several years ago, that at 36,000 feet there were clouds still above him.

The present records for both free balloons and airplanes are well up into the stratosphere—above 50,000 feet. The Italian, Pezzi, flying a Caproni biplane, several years ago set the airplane record at 56,046 feet, while Stevens and Anderson of the United States Army Air Corps hold the absolute altitude record, made with a free balloon in 1935, of 72,395 feet.

With the general picture well in mind, let us examine the most important altitude problems. First of all, if your plane is to be capable of flying at 50,000 feet, you must obviously have a powerful enough engine to take you up there. This is by no means a simple problem, and is the first of the three chief ones.

In general, airplanes do not fly well over 10,000 feet above the maximum rated altitude of the engine. That is, if you have a 10,000 foot airplane, then at 20,000 feet the plane is approaching its ceiling. Consequently, if you want to fly reasonably well at 50,000 feet, your airplane should have an engine with a maximum power altitude of at least 40,000 feet.

At present we do not have, for immediate application, any method of engine supercharging which will give us a critical engine altitude of 40,000 feet. About the best that can be done is 25,000 to 30,000 feet with the turbosupercharger, which is a supercharger driven by the energy of the exhaust gases. With improvements in turbo cooling and materials, and also in the general design and control features, it is probable that the turbo will not find it too difficult to carry us up to 40,000 feet. A reliable unit will undoubtedly be available in the near future, but not tomorrow.

Even if the turbosupercharger will make it possible for us to attain our desired altitude, we must be able to live there. This is the second principal problem—the physiological one.

The fraternity of high-altitude pilots has learned from experience and from tests in air-evacuated chambers at sea level, that the highest altitude that man can attain using an oxygen mask is about 35,000 to 40,000 feet. Some pilots cannot even reach these altitudes; all need frequent and lengthy rest periods between high-altitude flights. Any temporary interruption in the oxygen supply, no matter how brief, will impair the mental and physical functioning of the pilot, and perhaps even lead to a catastrophe. As one pilot said: "You feel all right until you are completely gone."

Figure 4.
A comparative airfoil section chart.

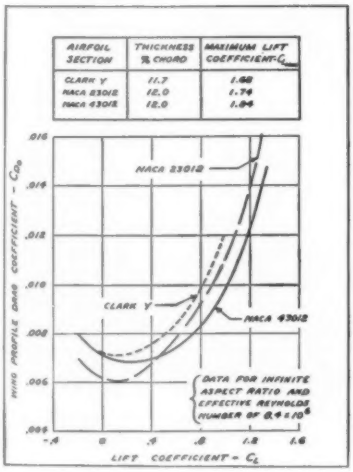

AIRFOIL SECTION | THICKNESS % CHORD | MAXIMUM LIFT COEFFICIENT-$C_{L_{max}}$
CLARK Y | 11.7 | 1.68
NACA 23012 | 12.0 | 1.74
NACA 4312 | 12.0 | 1.84
NACA 23012
CLARK Y
NACA 4312
DATA FOR INFINITE ASPECT RATIO AND EFFECTIVE REYNOLDS NUMBER OF 6.4×10⁶
WING PROFILE DRAG COEFFICIENT - C_{D_0}
LIFT COEFFICIENT - C_L

Figure 5.
Effect of operating altitude on wing.

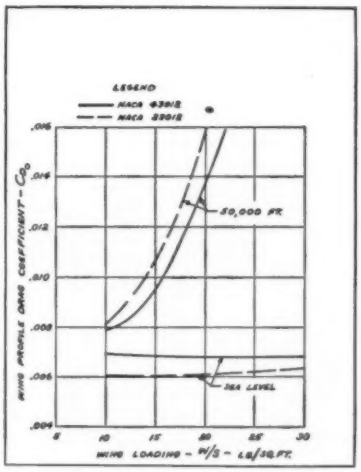
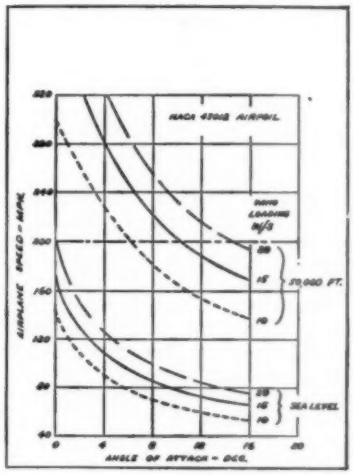


Figure 6.
The wing angle of attack required.



All these difficulties are averted if recourse is made to the pressure cabin. The pressure cabin is old stuff even to airline passengers, who have traveled from coast-to-coast in the Boeing *Stratoliners*. However, the cabin supercharging equipment on the *Stratoliner* would not meet our needs, since in this airplane a cabin pressure corresponding to 10,000 to 12,000 feet cannot be raised above 18,000 to 20,000 feet. It is obvious that a similar but more powerful cabin supercharging system is the principal answer to the physiological part of the high-altitude problem.

One other phase of the physiological problem is often neglected, but it is extremely important. The high-altitude pilot and passenger must be kept warm and comfortable. Special attention must be given to supplying adequate heat, and in providing comfortable seats and clothing.

While we must have enough power to bring us to 50,000 feet, and sufficient physical comfort to enable us to live there, if the airplane itself is not well designed it may be difficult or impossible to get to that altitude. That is, the thrust available from the propeller may not be enough to offset the total drag of the airplane. This brings us to the third important problem—that of basic airplane design.

The total airplane drag is made up of three components: wing profile drag, wing induced drag and parasite drag of the rest of the airplane.

Although at sea level and at low altitude the induced drag is relatively unimportant for cruising and maximum speeds, at high altitude the induced drag becomes of major importance. A typical induced drag variation with both span loading and altitude is shown in Figure 2. (Span loading can be calculated by dividing the airplane gross weight, W, in pounds, by the wing span, b, in feet.) It is at once evident that there is a considerable increase in induced drag with altitude, and the higher the altitude the more important the span loading becomes. At 50,000 feet a span loading of 40 has less than half the induced drag of a span loading of 60, and one-sixth that of a span loading of 100.

Although wing induced drag depends primarily on span loading, the wing profile drag depends on wing loading, W/S (pounds per square foot of wing area). Assuming a certain airplane speed, the lift coefficient, C_L, required for flight at that speed, increases considerably with both wing loading and altitude, as shown by Figure 5. A wing loading of 10, and even five, would appear to be very attractive under the circumstances. It is to be noted that even at these low wing loadings, at 50,000 feet the lift coefficients required are about triple those needed at 25,000 feet.

Since the lift coefficients must of necessity be high, it is at once obvious that the wing drag coefficients must be kept as low as possible. Therefore, it is necessary to choose a wing or airfoil section which will fulfill this condition.

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Ideas Make Airpower

The American aircraft worker has proven himself to be a man of ingenuity in devising practical material and time-saving methods of increasing our plane production.

THE American aircraft worker is quite a guy. He's not just a robot who stands out there in the factory with a drill or a rivet gun in his hands. He's a guy with a head on his shoulders and brains in his head, and Uncle Sam's aircraft manufacturers have recognized him as such.

One of the best illustrations of this is the aircraft plant at Seattle, home of the B-17 bomber, the famed *Flying Fortress*. Company officials long ago realized that the aircraftsman is a man of ideas. He's

Worker dropping suggestion in box retains stub of his idea form for identification.

proud of the job he's doing, the planes he's building—and he's anxious to make the planes even better and the production even faster. Last January the plant organization put into effect a program that gave the worker a chance to use his ideas, to shout them right out loud for the management to hear.

Throughout the plant were installed suggestion boxes. Beside them were stacked suggestion blanks, and the workers were quick to make use of them. It was all very simple. Just write on the blank your idea to help production or to improve the airplane's design (or your complaint if you have something you want to squawk about). Then drop it in the box.

It wasn't anything brand new, of course. The suggestion system had been in use here and there throughout business and industry for years, with varying results. But the way it went across with employees was one of the minor marvels that have gone along with the tremendous miracle of America's mass production victory.

This is a war that calls for teamwork, and the employees realized it. They accepted the chance of entering into close partnership with their company's management. They have a double incentive to inspire them: every useable idea they contribute will help just that much in outproducing the Axis, and at the same time will earn them a cash award. Their response has swamped the suggestion staff under an avalanche of ideas exceeding early expectations both in quantity and quality.

In the program's first four months a flood of 3,554 suggestion blanks had poured into the industrial engineering department, which handles the plan. Of these, 2,842 were found unsuitable, 672 still are under investigation, and 40 have been accepted. The approved ones range from design changes on the new B-17F, through tool, jig and fixture designs, down to minor safety suggestions. The volume of returns has put this plant up among the companies with long-established suggestion systems, some of which have been operating for 25 years.

From 40 to 50 suggestions are picked up daily from the collection boxes in the Seattle plants. To be eligible for awards, they must lead to improvement of production or design; reduction of cost; improvement of manufacturing method; elimination of waste and spoilage; elimination of accident and fire hazards.

Head of the suggestion program at Seattle is R. W. Boise, Jr., an industrial engineer with a great deal of experience. Coming to the company in September, 1941, he lost no time in getting the ingenious and highly practical system set up

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George Mathay contrasts new "squeeze" in right hand with older model he improved.

DIVE BOMBING TEETH

by MICHAEL AMRINE

A flying dentist discovered that the state of a pilot's teeth may determine his sense of balance in recovering from steep power dive.

Dr. G. E. Willhelmy

THERE is hardly a citizen who hasn't read of the super-speed attained through the power dive technique developed by U. S. Naval aviators. Or the fact that at the bottom of the dive the pilot's body may "weigh" as much as 10 times its normal weight, and that in "pulling out" blood is drawn from the brain, often causing a complete "blackout."

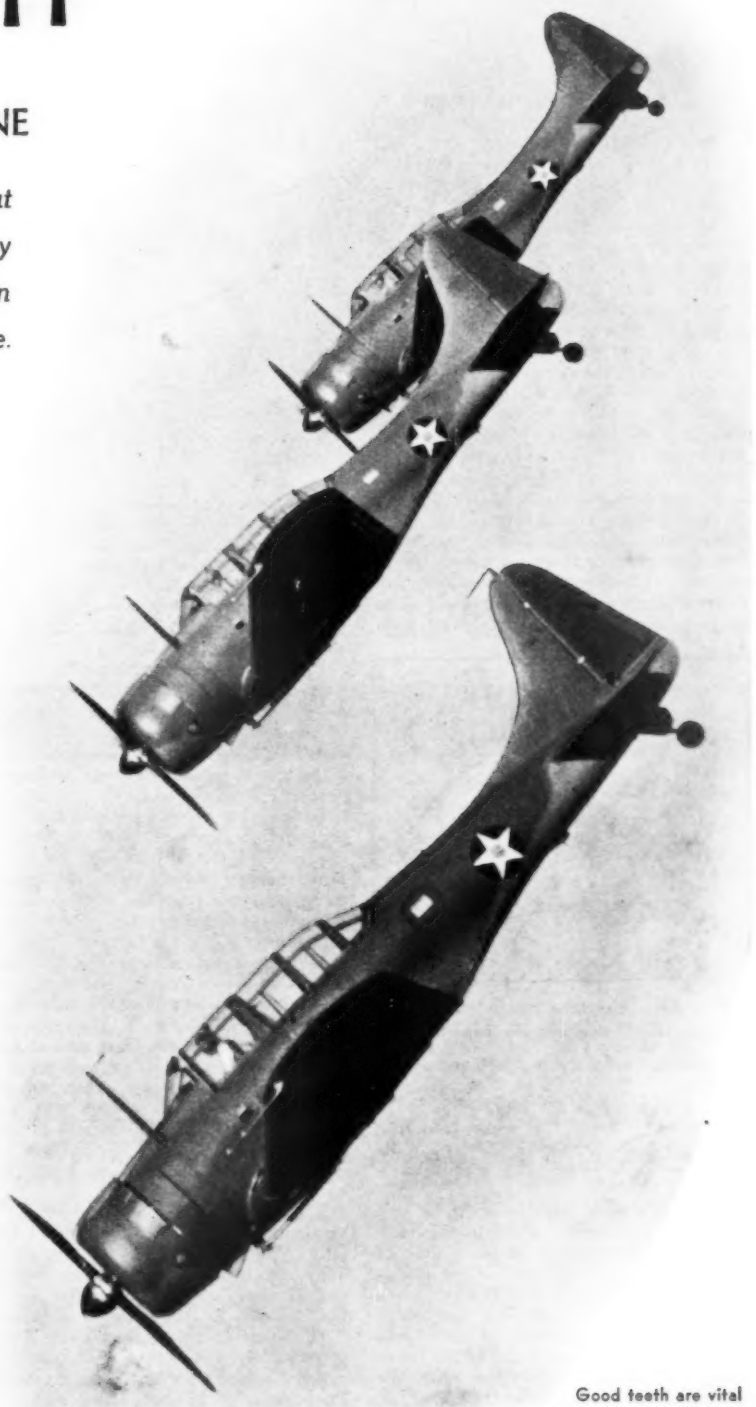
Today these facts are commonly known and associated with the dive bomber. But almost as uncommon is their association with the Eustachian tube, the condition of the pilot's teeth and their relationship to his sense of balance.

With all of this is closely woven the story of Dr. Glenn E. Willhelmy, the flying dentist of Kansas City, Mo., who first observed and recorded the strange fact that bad teeth may prove fatal for dive bombers.

An appreciable proportion of the men drafted for our Army are rejected because they are physically unfit. Defective teeth account for the largest per cent of these rejections. In the air branch of the service, rejections on account of teeth are in greater numbers than in any other.

In Army and Navy medical bulletins the name of Dr. Willhelmy figures often where aviation medicine is concerned. And always he is given full credit for tracing the relationship between good teeth and the Eustachian tube—between the Eustachian tube and the inner ear, which controls the sense of balance that every pilot must have.

Today both branches of the service have written into their rules for medical examination of recruits rigid requirements, a part of which are the results of Dr. Willhelmy's research. Many a pilot now knows that he can literally be saved



Good teeth are vital in diving these SBD-3's.

"by the skin of his teeth," because the state of his teeth may determine his sense of balance.

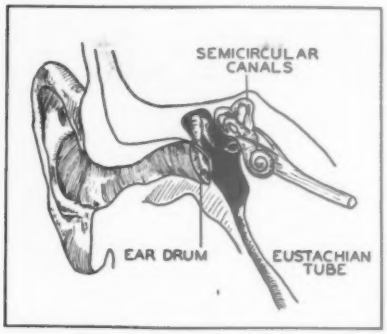
On each side of the head these Eustachian tubes run from the back of the nose to the ear. Unless there is something wrong with the tubes you would never know that you have them. From the center of the head, a little in front and above the wisdom teeth, this tube follows a path back and slightly up to the opening of the inner ear. Its only function is to ventilate the inner ear. Why the inner ear needs to be ventilated is something for another discussion. Certainly the world would be simpler if the inner ear were locked away in an airtight chamber or ventilated as is the cabin of a *Stratoliner*.

But it is not. The air pressure inside the ear changes from time to time. It must change exactly as the air pressure on the outside changes—if not it will be blown up from without or within.

What has this to do with the teeth?

A long time ago young Glenn Willhelmy, a native Missourian, was wondering whether to be a pilot or a dentist. He decided to become a dentist interested in aviation. He attended Oklahoma University at Norman, and Kansas City Western Dental College, receiving the degree of doctor of dentistry.

In 1929, he began to practice in Kansas City. Naturally, since he was an aviation enthusiast and a frequent passenger in commercial and private planes, many of Dr. Willhelmy's early patients were pilots or men connected in some way with



The Eustachian tube can be affected adversely if dentures are imperfect.

the aviation industry in the Kansas City area.

In 1933 a TWA pilot came into Dr. Willhelmy's office. His teeth were out of line; they wouldn't fit. "Dutch" Willhelmy was the man who would know why.

The pilot's teeth were found to be in a condition described as "malocclusion." This meant that the front teeth did not fit evenly; they overlapped. After studying the impressions, Dr. Willhelmy made a pair of gold "shoes" for the man's mouth. These consisted of thin gold plates to build up the height of the lower teeth. A second impression with the "shoes" showed a perfect bite and no overlapping. The "shoes" were made in such a way that they could be worn permanently or taken out at the will of the wearer.

An example of a perfect "bite." Teeth of this type indicate perfect balance.

The device had a most extraordinary effect on the pilot. That night on his flight out of Kansas City he found it was necessary for the first time in five years to use cotton in his ears. The temporary deafness which he had always had for a few hours after landing was gone. A slight dizziness which he usually experienced when rapidly losing altitude was not felt at any time during the flight.

Upon his return to Kansas City, he reported these facts to Dr. Willhelmy, who asked for more information, more details. This was the first time this curious reaction had been noted by medical science, although it is now almost universally recognized.

Before this it was generally assumed that "flying deafness" was the result of the roar of the airplane motor just as boilermakers become deaf from the intense vibrations of the hammers. The patient was asked not to wear his "shoes" on his next flight. He found that his temporary deafness returned. Other pilots who had reported the deafness were given the same test. Their reports agreed. It was proved to Dr. Willhelmy's satisfaction that the deafness on sudden drops did not occur when an impression of the teeth showed a pilot to have an even bite. He made further tests with pilots who did not have this trouble of overlapping teeth. Only in a very few cases did they report the deafness, dizzy spells or the loss of balance.

The next step in Dr. Willhelmy's investigation took him to the field of anatomy. He was looking for the reason. Why did this pilot experience deafness and dizziness only when he flew without his "shoes"? At last he found the answer.

The entrance to the Eustachian tube is guarded by two "tensor" muscles (so called because they are normally tense). They contract in such a manner as to open a passage from the mouth and thus permit air to circulate up to the inner ear. If the teeth do not meet evenly the jaw muscles may operate, as in the case above, to relax these tensor muscles.

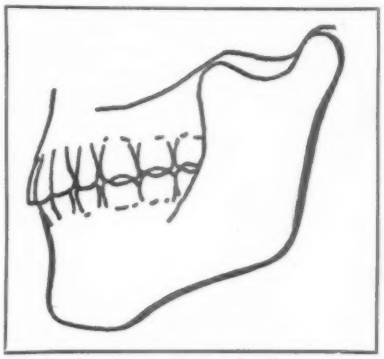
Dr. Willhelmy continued his examination, making impressions of other pilots known to have this same trouble. In each case he studied the action of the jaw muscles and the tensors. Finally he was able to announce his findings:

"If the tensor muscles, due to the reaction of the jaw muscles to overlapping teeth or any form of improper bite, close the entrance to the Eustachian tube, the loss of altitude in landing or in any sudden drop, such as the dive bomber takes, will set up a stronger pressure on the outside of the ear than exists on the inside. This may and probably will create deafness, dizziness or even unconsciousness."

How many airplane crashes can you recall where there was never a reason assigned for the accident? Remember reading of the veteran pilot, who, while doing dive bombing, spun in instead of pulling out? Apparently no mechanical failure. Certainly the pilot wasn't frightened. Could the answer be dizziness?

Dr. Willhelmy recalls many such cases. He also recalls that pilots he examined mentioned "stuffiness" in their ears.

While convinced he was on the right trail it was three years before his work was officially described in the United States Naval Medical Bulletin. However, after examination of many cases the young dentist made the statement that he reiterates today: "The 'overbite' may be the missing factor of X that crops up in some of our unexplained air crashes. The trouble is that when a pilot feels a



Overlapping teeth may be the cause of faulty balance and trouble with ears.

slight dizziness he says nothing about it. And, if he feels a great dizziness during flight, he doesn't come back to say anything about it."

This is particularly true of the drop taken by the dive bomber who, after he has sighted and released his load, must retain perfect balance to avoid crashing the plane into the target.

Back of the doctor's findings is the fact that at ground level the pressure of the air is about 14 pounds to the square inch. But at 18,000 feet the pressure is only eight pounds to the square inch. Dropping from 18,000 to 500 feet is not too much of a job for the ear in adjustment if the drop is gradual. But take the case of a dive bomber where the pilot approaches his target at nearly the speed of a bullet. If the Eustachian tube is not

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"Dear Mr. Manufacturer . . ."

"... a cabin that's roomy, with good vision."

Mr. Pierce is the west coast director of continuity for the Columbia Broadcasting System, with headquarters in Hollywood. He holds a private license, is married and has three children. He himself plans on buying a "real family ship" after the war is over. He is one of the originators of the aviation department of CBS and has broadcast from a glider, a dive bomber and a forestry patrol plane circling over one of the west coast's major forest blazes. Born in Columbia, Mo., he is 32 years old.

Paul Pierce

by PAUL PIERCE

Joe Doakes, typical American, has a clear idea of the sort of plane he would buy in post-war era. Here are his specifications.

GENTLEMEN:

We don't want to bother you while you're busy winning a war. What we have to ask of you isn't important now. Just put this request on file and keep it until better days arrive—but don't forget it when the war is over. It will be tremendously important then!

We are the relatively few pilots and plane owners who were flight conscious before wings crashed the headlines. We are the thousands upon thousands of young men who are learning to fly now with a sterner purpose in mind. Most important to you, we are the millions who still have to learn that flying is the supreme means of transportation. We are the flyers of tomorrow.

You may consider this letter of early date as an order for an airplane. You build it and we'll buy it. Naturally we expect it to meet our specifications and we presume that it will be priced to meet our pocketbook. We'll take delivery as soon as you fill your present orders, which call for fighting planes rather than family wings.

We are a pretty varied bunch of individuals, and it might be well for us to appoint one of our number to act as spokesman. Joe Doakes is a good man for that because he already knows something about flying and he and his family are close enough to average so that you'll get a true picture of how we feel and what we want.

Joe is 31 years old, married and has two children. He used to work for a newspaper, but now he has a better job writing for a radio station in the daytime, and at night he's an air-raid warden. He meets a lot of people, and his newspaper training makes him ask questions. He puts the answers with his own ideas and therefore has a pretty broad viewpoint. He makes about $5,000 a year, which is neither too much nor too little. He lives in the west (which has something to do with the airplane he'd like to own).

Joe started flying about four years ago and finally soloed a *Cub*. Josephine, his wife, never objected to his hobby, but to date she hasn't flown with him because she feels that the kids should have someone to look after them if anything happens to daddy. Joe's flying took quite a bit of money, and in four years he'd only

piled up 150 hours. He holds a private license but he hasn't flown since December 7th, 1941. His ambition is to become a really safe pilot so that his family can share the pleasure he gets from flying with no misgivings. Joe isn't a very flashy guy, is he? No, but Joe is going to buy an airplane after the war.

Joe's been thinking a lot about the airplane that he'd like to own and he's decided that first of all it has to be safe. He intends to carry some precious cargo in that plane of his. Joe had a few hours in an *Ercoupe* and marvelled at the sense of security it gives the pilot. He had a few more hours in a Stinson "105" and even tried to spin it, with no success. He checked with several airplane designers who had actually been forced to build spin characteristics into planes for training purposes, and he wondered "why?" when he read of a great many accidents which started with inadvertent spins. Joe decided that his airplane must be spinproof. Further than that, Joe still is trying to find an expert who can tell him why any airplane should be spinnable. He thinks snap-rolls, vertical reversements and other violent maneuvers are entirely unnecessary. He may want to do a mild chandelle or vertical to let off steam, but his airplane is to be used for cross-country, not aerobatics. Joe's plane will have a tricycle landing gear which will make it possible for Joe to set the ship down almost anywhere and stop it in a hurry. It will also free him from one of flying's most worrisome problems, the smooth landing at close to stalling speed. In fact, with the tricycle gear, Joe will never have to take the risk of slowing down to anywhere near stalling speed when he's close to the ground. Cross-wind and down-wind landings, when necessary, will become routine matters to him instead of hair-raising adventures.

Joe's plane is going to be twin-engined, but don't think that he has an airliner complex. He's learned that two light engines are actually cheaper to maintain than one big, complicated brute and will carry the same load with a greater safety factor. One small engine, operating at full throttle, will enable him to maintain his altitude, or at least stretch his glide a long distance, in case of engine failure. One big engine when it goes, is gone—and Joe has to start looking for open country in a hurry.

The size of Joe's airplane has him worried. He really needs room for five people (and five places seems right to him because of the family sedan). He's afraid that a five place ship is going to be pretty expensive, but he's hoping that new materials and methods, developed during the war, will make airplanes of this size economically possible for the average owner.

Another thing that Joe needs is a healthy baggage and equipment allowance. Two hundred pounds would be the minimum to allow for the extra instruments he'd want, and change of clothes for mama and the kids. Then, too, remember, Joe lives in the west where distances are great, and he will want a good gasoline reserve to fly around those des-

(*Continued on page* 135)

AIRCRAFT OWNERS AND PILOTS ASSOCIATION

AOPA NEWS

The Aircraft Owners and Pilots Association, with Service Headquarters in the Michigan Square Building, Chicago, Ill., is a non-profit organization formed and composed of non-scheduled aircraft pilots and/or owners exclusively. The AOPA operates with a full-time professional staff and is the largest group of civilian pilots in the world. The views and statements of opinion contained in this column are those of the Aircraft Owners and Pilots Association and not necessarily those of FLYING. This column is edited by the staff of AOPA for its members and other interested parties. Special releases of a more confidential nature are additionally sent each month to all registered members.

AOPA Plans Additional Service

THE split-second timing of national aviation events has frequently made it impossible to carry to AOPA members, either through the AOPA News or the AOPA Section (both published monthly), certain pertinent information pertaining to the war effort and personal flying problems before the information had become stale. As a result, AOPA's staff has been working on plans to augment the AOPA News and AOPA Section with a Washington newsletter.

By this means it is thought that pertinent information and news can be brought to members by direct mail as important changes and developments take place.

Members are asked to express their opinions regarding the distribution of such a newsletter service. Your individual suggestions regarding type of information you would like to have and the manner of presentation will be most welcome. Address your ideas to the Washington Service Office, Carpenters Building.

AOPA and CAP

Many of the AOPA Units have instituted CAP squadrons or are acting as the administrative headquarters for the activities of the CAP in their respective regions. Pictured this month is a banquet which was held for joint AOPA members and CAP Squadron No. 1 of Denver, Colo.

Ray Melberg, AOPA 7306, who has been conducting AOPA affairs in Denver, arranged for this dinner which, like many other CAP units, was composed predominently of AOPA registered pilots. **William Gazin**, prominent in theatrical circles, arranged for a complete show which was augmented by an interesting discussion by **Paul Briggs** on airplane construction.

Harold R. Smethills, AOPA 4316, captain, acting in command CAP Wing 83 in Denver, is likewise due much credit for his co-ordination of AOPA and CAP activities.

Eastern Dodo Birds, Attention!

The AOPA Washington Service Office is at present compiling a list of airports located just within the midwestern limits of the Eastern Air Defense Zone for the convenience of OAPA members who wish to continue their flying.

In this month's AOPA Section (confidential monthly bulletin sent to all AOPA registered pilots) is listed the first tabulation of airports available to AOPA members in New England and the middle Atlantic seaboard.

Individual assistance will be given to all members in locating airports closest to their places of residence where they may continue their flying. If you have a particular problem, write to the AOPA Washington office, giving your AOPA registration number and complete details regarding type of equipment desired, etc.

Operators who are located outside this zone are urged to file with AOPA information relative to their equipment and

(*Continued on page* 104)

Many AOPA members are actively engaged in CAP activities. Below is pictured a joint banquet held by the AOPA Unit, of Denver, Colo., and CAP Squadron No. 1, recently.

THE TRUSTY 'OX'

by THOMAS F. BUCK

The standby of Army training and early barnstorming era was this Curtiss JN-4, the beloved OX-5-powered "Jenny" of early birdmen.

Memories of the famous engine of World War I fly with pilots in this war of the air. Many of today's outstanding airmen were trained on aircraft powered with the redoubtable OX-5's.

THE new Allison engine, it has been said, is an "OX with hair on its chest." We agree. And we will extend that statement by saying that the OX-5 (a motor loved by many flyers and feared by many others) will have done as much to win this war as all the Allisons and Wrights, and Jacobs and Continentals that are powering our superior ships on all fronts of this war. In an indirect sort of way, of course.

Our tongue is in our cheek when we say that the motor of the last war is going to win this newer, more modern affair. Our contention is that because of the performance, the economy, the adaptability of the Curtiss OXs, thousands of American civilians have, in peacetime, become experienced and capable flyers. OX-trained flyers are the fathers of our flying forces of today. Make a survey of the thousands of instructors on the training fields of the Army or Navy and you'll see what we mean. You'll find that most of the older instructors have had time on ships that have been powered with an OX. And if you question these old timers they'll tell you that they wouldn't trade their OX time for triple the time in other comparable civil ships that are crowding the airways today.

We're not squeezing sour grapes on the newer motors, mind you. They're better, they're lighter, more powerful and have every advantage over the OXs. But when the OXs were newer, they were the power plants for countless pilots who since have become famous.

Brig. Gen. James H. "Jimmie" Doolittle is an OX-er. True enough, he didn't depend on an OX to power himself to Tokyo, nor did he set transcontinental speed records with an OX, but his early training was in a Curtiss JN which had an OX-5 in it. Mayor Fiorello H. LaGuardia, who gave up flying for politics, is an OX-er. He, too, did his OX-ing in the last shindig in OX *Jennys*. And so it goes—check down the list of famous pilots in the United States and you'll find that perhaps 75 per cent of them have had time in OX-s and you'll find every one of them full of praise for the motor that gave them their first thrilling experiences in the air.

The OX, by way of a biography, is a

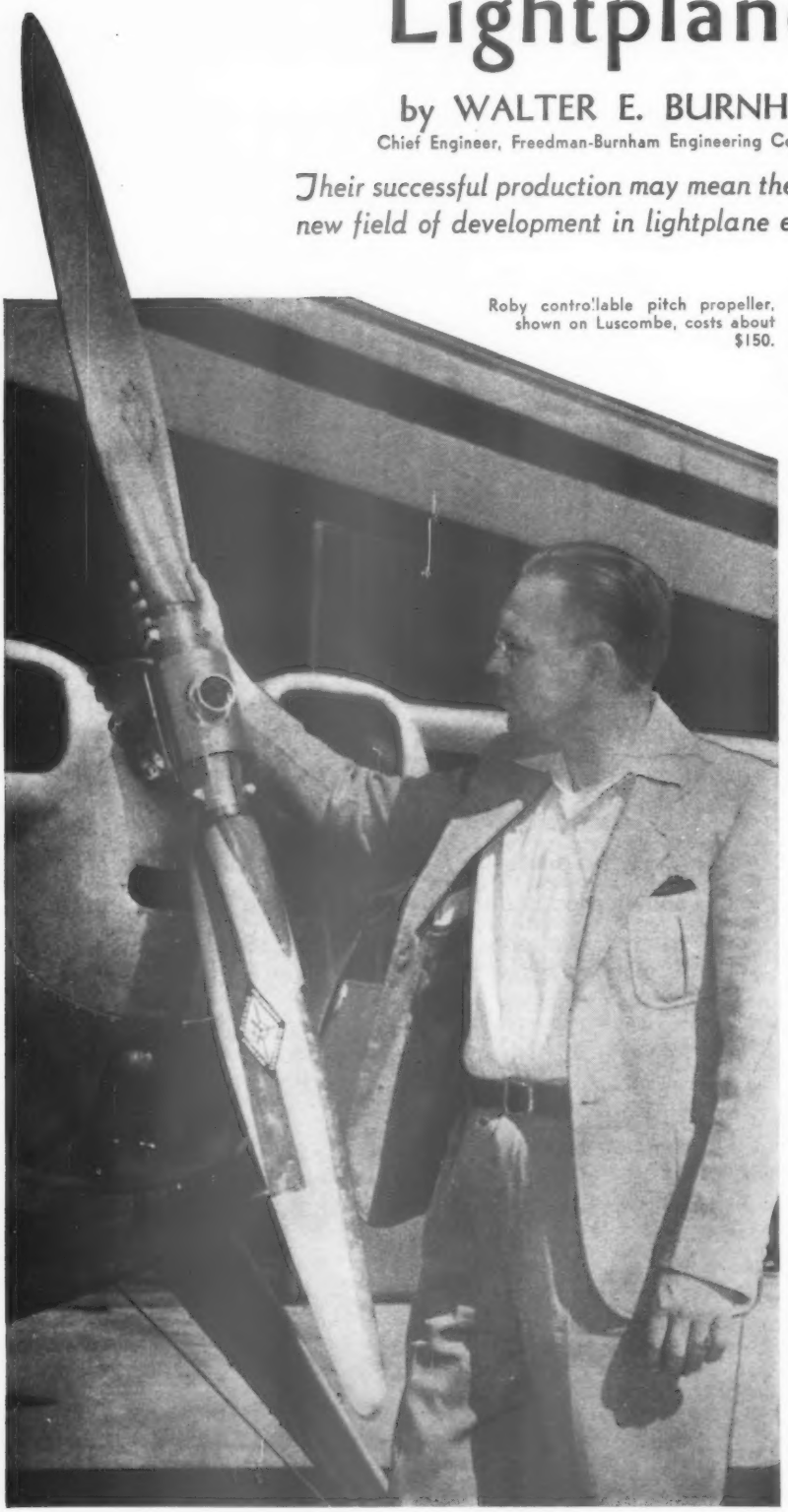
(*Continued on page 70*)

The OX-5 was standard equipment on many early airplanes such as this Waco "10."

Controllable Propellers for Lightplanes

by WALTER E. BURNHAM
Chief Engineer, Freedman-Burnham Engineering Corporation.

Their successful production may mean the opening of a new field of development in lightplane engine design.



Roby controllable pitch propeller, shown on Luscombe, costs about $150.

THREE and one-half years of study have produced designs sufficiently simplified and standardized that it appears that an entirely satisfactory controllable propeller may be marketed for a cost not exceeding $2 to $2.50 per horsepower for engines ranging in horsepower from 75 to 400. This is in contrast to the existing cost of controllable propellers for large airplanes which is roughly $3 to $4 per horsepower, a prohibitive cost for the average lightplane operator.

Inventors, designers and propeller manufacturers have felt the need for a lightplane controllable propeller for many years and have spent large sums of money in experimentation. The designers of low horsepower, multi-engined airplanes were probably the first to seriously feel the need for such a propeller. With the comparatively recent development of high performance lightplanes, this need has been extended until it approaches the proportions of a restriction to further progress in airplane design of low horsepower. However, the introduction of a controllable lightplane propeller opens a new field of development in engine designs for lightplanes.

Since the introduction of the Freedman-Burnham adjustable pitch propeller at the Chicago Air Show in 1937, two propellers have received type test approval from the Civil Aeronautics Administration: the Roby controllable pitch propeller and the Everel automatic variable pitch propeller.

The initial problem, as already outlined, is cost. Since the mechanism, precision and labor requirements of the lightplane controllable propeller are essentially the same as the larger types, only simplification of design and standardization of parts will make possible the manufacture of such propellers at a reasonably low marketable price.

Another problem is that of maintenance. Modern transport airplanes and service craft are maintained by skilled propeller mechanics who are provided with special tools and service equipment. The lightplane owner will want a controllable pitch propeller which can be serviced and maintained by the ordinary airplane and engine mechanic with standard tools. One solution would be a design that would not require frequent maintenance; one that would only require long-period overhaul which could be

done either at the factory or at an approved propeller service station.

Weight and balance present still another problem, because a small increase in weight represents a greater problem for the lightplane than for the larger airplane. Further, large airplanes have been designed around either fixed-pitch, controllable or automatic, metal propellers. Whereas the lightplane, in general, has been designed around a fixed-pitch wooden propeller. At best, the controllable hub will be heavier than a comparable fixed-pitch propeller.

There are three manufacturers who make the largest percentage of lightplane engines. While these engines are of comparable horsepower and rated r.p.m., each has its own individual shaft end. Each of these shaft ends has commendable features and is the result of independent design sought out to be the most economical and dependable arrangement best fitted to meet the production facilities of the specific manufacturer. Although this has little or no significant effect upon the conventional wooden fixed-pitch propeller, it is obvious that the necessary complications of the adjustable, controllable or constant speed propeller hub will require standardization. This point is essential if a propeller of sufficiently low initial cost is to be developed.

The performance of any airplane is dependent on the thrust horsepower of the engine. That is to say, the performance of the airplane is dependent upon the propeller design. A propeller which provides for a maximum of thrust horsepower for all conditions of flight and take-off is, of course, the most desirable.

Aircraft in general have four distinct performance categories: take-off, climb, cruising and landing. In each of these categories, the propeller plays an important part. In the case of multi-engined aircraft, all these performance categories must be possible of execution with one engine inoperative.

In the case of an airplane equipped with a fixed-pitch wooden propeller, the angle of attack and consequently the thrust and torque forces vary as the speed of the airplane, or more specifically, as the speed of the air passing through the propeller disc changes. When the airplane begins to take off (see Fig. 1) the air velocity passing through the propeller is equal to one-half the slipstream velocity with the airplane stationary, and the angle of attack of each element of the propeller is nearly equal to the blade angle. As the airplane gains speed (see Fig. 2) the airspeed through the propeller increases, being equal to one-half the slipstream velocity plus the speed of the airplane, and the angle of attack blade elements decreases until at cruising speed or top speed. Depending upon the design of the propeller used, the angle of attack is the angle for best L/D or efficiency for the blade elements. It follows that, if the propeller is designed for best L/D at top or cruising speed, at take-off speed or climb speed the lift and drag, and consequently the thrust and torque, forces are greatly increased. This increase of thrust and torque obviously holds the engine down to a revolution speed considerably below the designed r.p.m. The engine in turn develops less horsepower at reduced speed, which causes a further reduction in thrust horsepower.

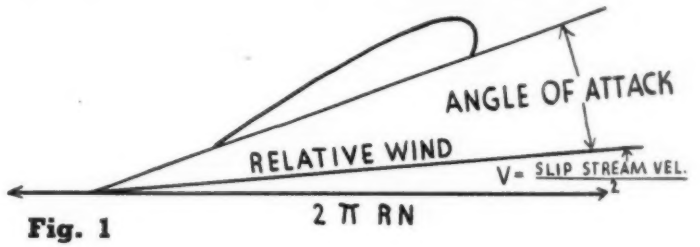


Fig. 1

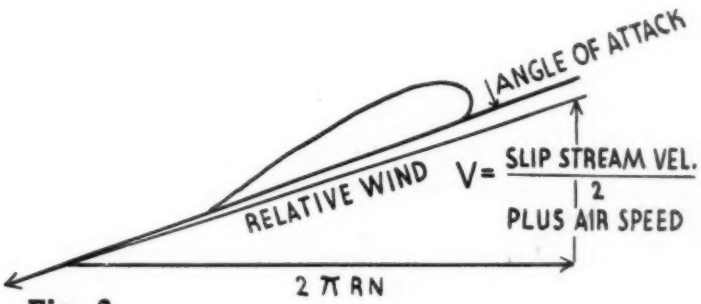


Fig. 2

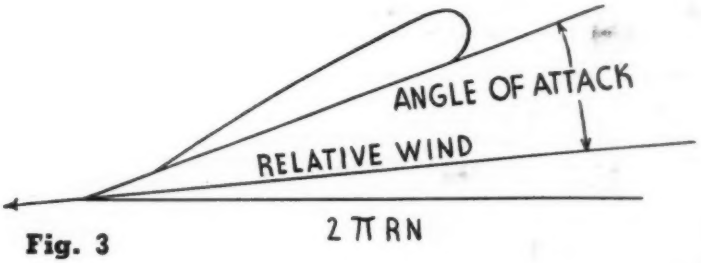


Fig. 3

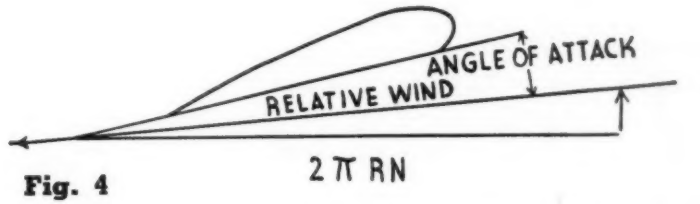


Fig. 4

By comparing Fig. 3 and Fig. 4 it is noted that the take-off angle of attack of the blade element is greater for the high-pitch propeller than for the low-pitch propeller. This indicates that, assuming equal engines, the engine equipped with the high-pitch propeller will be held down more than the engine equipped with the low-pitch propeller. Thus it follows that in the take-off condition, not only the brake horespower available will be less for the engine equipped with the high-pitched propeller, but the efficiency of the blade element will also be reduced resulting in an additional loss of power when compared with the engine equipped with the low-pitch propeller.

From the foregoing, it is obvious that if a large difference exists between take-off and full flight r.p.m., the take-off performance and perhaps the climb performance will be seriously handicapped. If this difference becomes too great, it will be impossible to get the airplane off the ground under its own power. However, if it were catapulted up to near cruising speed by some outside source, flight would be satisfactory. On the other hand, if a fixed-pitch wooden propeller having

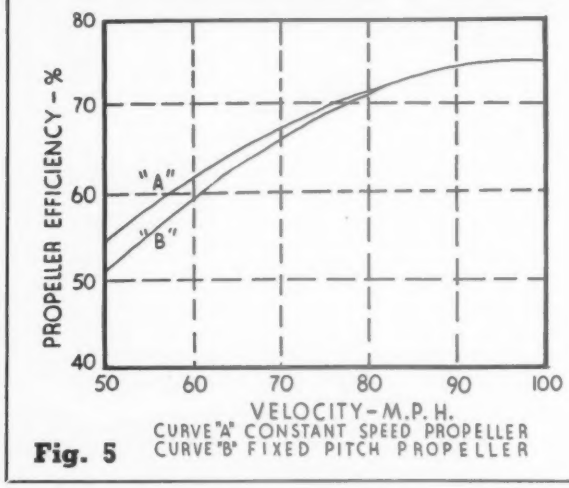


Fig. 5

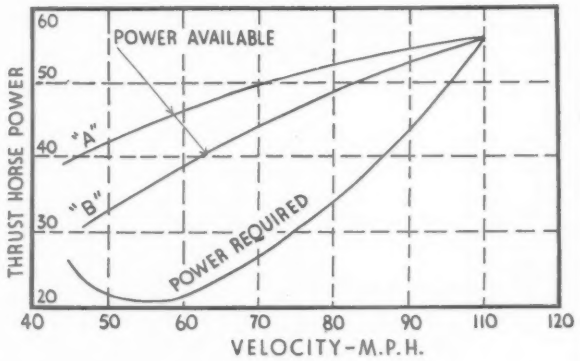


Fig. 6

a low pitch is employed, the engine will over rev when it is in the air, and a serious loss of efficiency results at cruising or top speed. There are two ways in which this difficulty may be overcome. First, by the use of a variable speed transmission (which will not be considered here), and second, by the use of a controllable pitch or constant speed propeller. In the case of the controllable pitch propeller or constant speed propeller, the action is as follows:

At take-off, the pitch is reduced either automatically or by the pilot so that the engine is permitted to rev up to rated r.p.m. (Take-off r.p.m. where the engine is so rated.) This insures full brake horsepower of the engine for the take-off. Furthermore, the reduction of pitch necessary to allow the engine to turn up to rated r.p.m. also tends to increase the efficiency of the blade elements, and consequently, a greater percentage of the available brake horsepower is converted into thrust horsepower. Fig. 5 shows a comparison of efficiencies of a fixed-pitch and a controllable-pitch propeller.

During the climb period, the pitch is adjusted to accommodate the increase in velocity and consequent decrease in angle of attack picked up during take-off. Here again the angle of attack is near the optimum angle with a consequent high efficiency. As the airplane is leveled off into cruising or full flight, the pitch is further adjusted so that full brake horsepower is used. In this condition the propeller is usually operating the same as a fixed-pitch propeller, since the fixed-pitch propeller is generally designed to hold the engine down under full flight conditions.

In some cases, where it is desired to emphasize take-off and climb, it may be that the top speed performance of the airplane equipped with a controllable pitch propeller will be slightly penalized, but it may be shown that if the propeller blade is designed so as to favor, slightly, the climb performance, the cruising and top speeds are not appreciably affected.

Fig. 6 and Fig. 7 are typical performance curves for airplanes having top speeds of 100 and 130 m.p.h., respectively. These curves are representative only, but serve to illustrate the range of lightplanes as they are currently known. Curve A of each figure represents the power available when the airplane is equipped with a standard, fixed-pitch propeller, while curve B represents the power available when a controllable-pitch propeller is used. It will be noted that the increase

Nose of Taylorcraft equipped with the Everel automatic variable pitch prop.

in excess horsepower for climb and take-off is considerable in both cases, but the high performance airplane has the greatest increase. When a controllable propeller is used, the rate of climb is increased approximately 50 per cent for the lower speed airplanes and approximately 80 per cent for the higher speed airplanes. The take-off performance has been proportionately improved.

It is to be noted that the highest speed of the low-speed airplane has not improved, while for the higher-speed airplane a small increase in speed is shown. This is because, for the high performance airplane it was necessary to use an extra large diameter fixed-pitch propeller in order to get reasonable take-off performance. In fact, it will be noted that the available horsepower of the fixed-pitch propeller at take-off is not too favorable even when this large propeller is used. When the fixed-pitch propeller is re-

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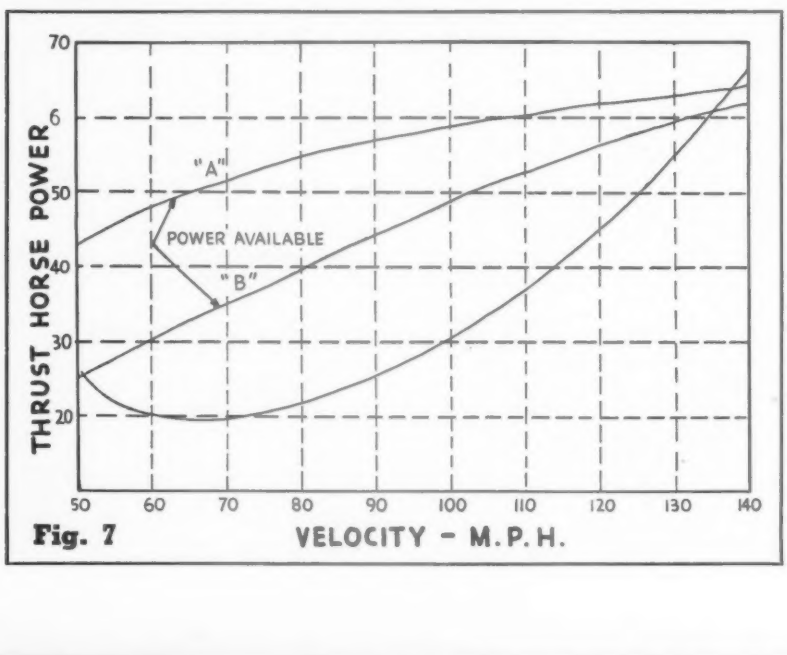
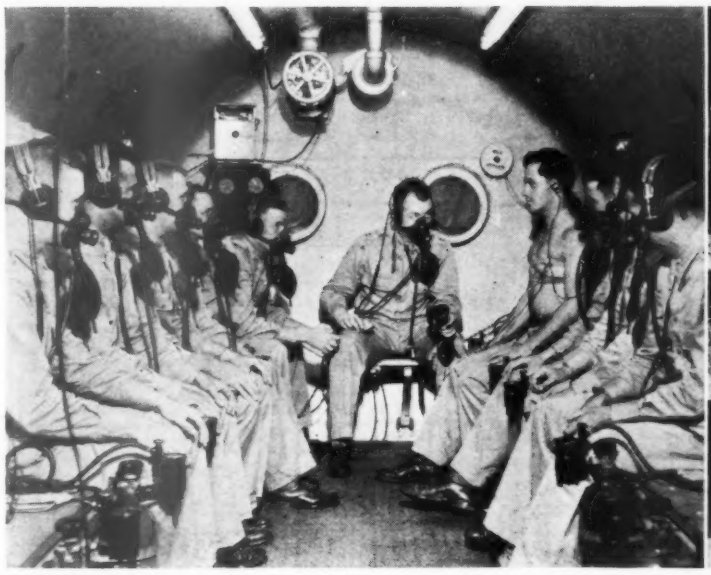


Fig. 7

AIR SERVICES Section



Occupant of seat 13, without oxygen mask, will demonstrate to fellow cadets the effects of high flight. Surgeon (at end) closely watches his reactions.

Capt. Harry Mantz, Maxwell Field flight surgeon, discusses physiological facts with instructors.

THE ARMY FLIGHT SURGEON

BACK in 1918, in the days when flying rated along with flushing five aces in a poker game as a means of committing suicide, one of the most important events in military aviation took place.

No new type plane roared into the post-war sky. No new, revolutionary engine made its debut. Something much more important to the future of aviation than either of these occurred.

The place was Mineola, L. I., and the event was the founding of the School of Aviation Medicine which today, relocated and enlarged, furnishes the Army Air Forces with its hundreds of flight surgeons now at work in Army hospitals and in research laboratories.

Today, typical of the set-up in the Army Air Forces, scores of flight surgeons, headed by Col. William F. DeWitt, Training Center surgeon, are on duty with the Southeast Army Air Forces Training Center, Maxwell Field, Montgomery, Ala., teaching youthful airmen the effects on them physically of certain kinds of flying, what is safe and what is foolish for them to do in planes, what precautions should be taken to prevent certain harmful results. In short, how best to live in their new world of the air.

For new world it is in this day of aviation when men methodically drop death on ant-like enemies 30,000 feet and more below them. At altitudes of this kind an entirely new concept of self-preservation must be instilled in the men who reach them. Similarly, a man behind the stick of a dive bomber or the pilot of a hot pursuit ship desperately trying to maneuver himself in for the kill, must know what he can "take" physically. Knowing this, he doesn't make the foolish and suicidal mistake of trying to stand more.

Back of this knowledge of what a pursuit pilot can stand physically, or how a dive bomber pilot should crouch as he pulls out of his dive (hidden from the glamour of the nation's front pages) lie days and nights, weeks and months, years even, of research into the effects of flying upon the human body. Chief among these researchers are U. S. flight surgeons—men who, in addition to their medical training, have been schooled in the intricacies of aviation medicine.

Altitude in flying today is limited not by the skill of the plane designer, not by the ability of a pilot to maneuver his plane, but by the ceiling of the human body—seven miles. This is the maximum at which even the best pilot, with the best apparatus, breathing 100 per cent oxygen, can safely fly. Yet new German antiaircraft batteries are now effective at 35,000 feet. Where most flying in the last World War took place at low altitudes, with 16,000 feet being probably the maximum height any plane in action could then reach, now it is found that bombers flying well over twice this altitude are no longer safe from enemy ground fire.

A way must be found for our men to withstand altitudes above this fire and today U. S. flight surgeons are working day and night on just that problem. At sea level there is sufficient pressure to force oxygen through the walls of the lungs and into the blood stream for distribution throughout the body. But as altitude increases, this pressure falls off and sufficient oxygen is no longer forced into the blood stream. At extreme heights not even breathing 100 per cent pure oxygen will suffice. But something must be found to suffice, and flight surgeons intend to find it.

Already a pressure suit has been developed in which an altitude of over 56,000 feet has been reached. But such a suit has been found too bulky, too restricting to the pilot, for military uses. Air-tight pressure cabins have also been developed and used for test purposes in military planes. The answer to higher altitudes will probably lie in these, flight surgeons believe.

But with high altitude flying go numerous other problems which must be solved by research. Students of aviation medicine are particularly concerned with counteracting fatigue at these altitudes. Men tire easily at 30,000 feet and as the altitude increases, so will the pilot's tendency to become fatigued. For combat crews to work effectively at these altitudes, a way must be found to arm them physically against this tendency.

Cold at these altitudes must also be

combated. Flight surgeons had to find out how much cold a man could stand and still maintain flying efficiency. At 20,000 feet, it is 12.3° below zero and at 30,000 feet, 48° below. The effect of such temperatures on men not properly protected results in mental depression and indifference to the task at hand. To combat this, electrically heated suits have been designed to protect the men.

Most of the research done by flight surgeons is carried on at the Aero Medical Research Laboratory at Wright Field, O., and at Randolph Field, Tex. But at Maxwell Field, headquarters of the Southeast Army Air Forces Training Center, flight surgeons are doing considerable research in the effects of high altitudes by means of a low pressure chamber.

Hundreds of aviation cadets each week are sent "aloft" in this chamber while delicate instruments measure the effect each stage of the ascent and descent has upon the young airmen. For flight surgeons know that cadets who understand the physical and physiological changes which affect them personally, and who know how to deal with them, will be much more efficient in the air.

To impress upon the embryo flyers the danger of high altitude flying without first taking necessary precautions, one man is picked out of each group to go aloft without benefit of additional oxygen until he approaches the fainting stage. The experience does no harm to the "guinea pig," since attendants are ready to give him immediate relief, but it makes a deep impression on the minds of the youthful pilots-to-be. From then on they believe what doctors in charge of the low pressure chamber tell them. To supplement this, lectures and a clearly-worded handbook serve to furnish them with a good working knowledge of the effects of decreased atmospheric pressure.

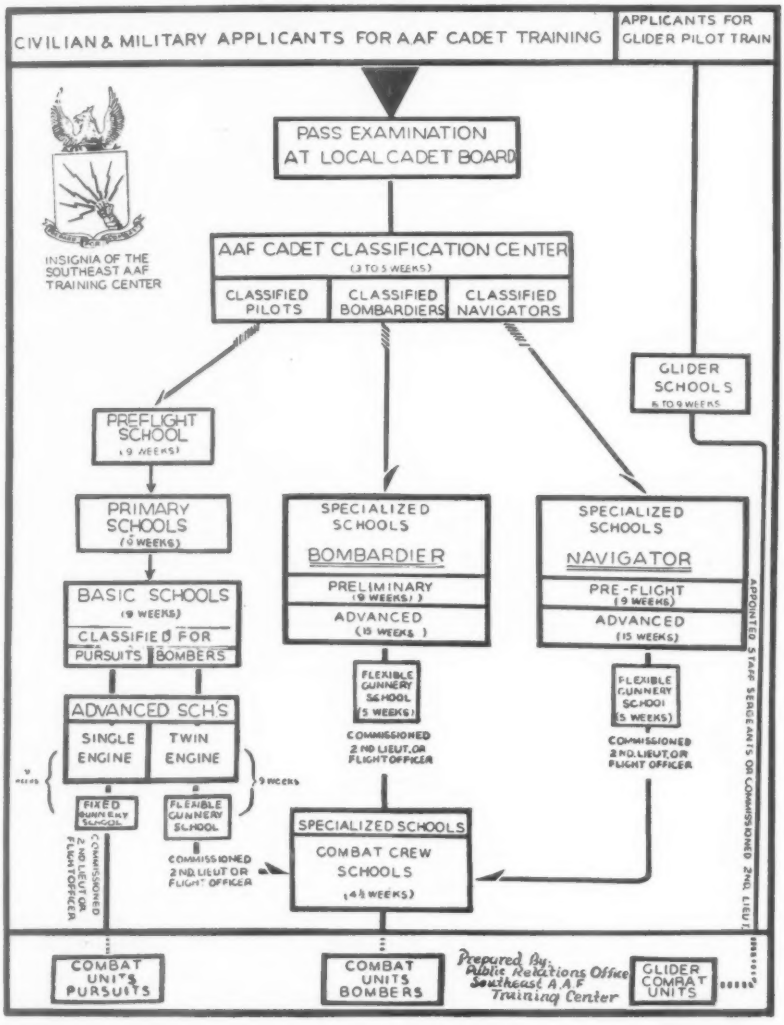
But research is only part of the work done by Southeast flight surgeons. Take Capt. Harry Mantz, flight surgeon for Maxwell Field. Mantz, young, affable and wide awake, spends a good half of his time hearing the problems of individual cadets who have run into trouble on their physical examination, and a good portion of his remaining time lecturing to pilots on the flight line about the physiological aspects of flying, and about the psychology of instruction. Whether informal lectures or informal "rag chews" on the flight line, Mantz gets the keen attention of his listeners, many of whom are veteran flyers. For they know that what he has to tell them may some day save their lives.

Not a pilot himself, Mantz has nevertheless done considerable flying in connection with his work. At Randolph, while attending the School of Aviation to win his rating as flight surgeon, he received three hours official instruction in flying. Since then he has learned quite a bit about flying by unofficial instruction from pilot friends.

Today flight surgeons are on the battle as well as home front. Only recently arrangements have been made for the aerial transportation of sick and wounded soldiers from theaters of war to medical bases within the interior, where proper treatment can be administered. Each evacuation is under the direction of a flight surgeon who, besides being a doctor, is familiar with the effects of air travel as well. Men too sick to travel by air, a condition which would be recognized by the flight surgeon, are transported by other means.

Doctors on active duty with the Army become flight surgeons by attending a six weeks' course at the School of Aviation Medicine, then supplementing what they have learned with six weeks' practical experience at some individual station. They are then rated aviation medical examiners and after a year's service under this status, are designated flight surgeons and presented with a pair of gold wings signifying their rating. Important work these men are doing? You answer that one. And the beginning was the unheralded founding of that school in Mineola almost a quarter of a century ago!

AAF CLASSIFICATION CHART



"THE best training in the world" sounds like a big statement—and it is—but that's what America's young men get when they are accepted by the Army Air Forces for training as pilots, bombardiers and navigators. The above chart, prepared by the Southeast AAF Training Center, shows the progressive stages of training Army aviation cadets undergo from the time they pass the physical and mental examinations at a local board or Army Post, until they emerge as 2nd lieutenants or with the newly created grade of flight officer. (Both ranks carry the same pay, and flight officers may later be commissioned as 2nd lieutenants.)

Upon graduation from the last stage of Training Center preparation, the young officers are assigned to a combat unit and are ready to meet the enemy. And because of their exceptional training, they will meet him on better than even terms in knowledge and ability. That means greater safety for themselves—as well as extremely bad news for their opponents!

Airport Traffic Record

SIX invisible sky highways over Randolph Field, Tex., the "West Point of the Air," carry what is believed to be the heaviest airport traffic in the nation, if not the world, more than 5,300 landings and take-offs a day. The 450 h.p. training planes used in the Army's basic flying training bounce on and off Randolph Field at the rate of one every 10 seconds throughout a 15-hour flying day. And this daily total is being increased as the expanded training program nears a 24-hour-a-day flying schedule.

To control traffic with several hundred planes in a swarming buzz over Randolph's twin fields as well as several auxiliary fields requires a skillful manipulation of traffic by flight dispatchers and control tower men, as well as a thorough knowledge of the traffic rules by instructors and students.

Since landings and take-offs must be into the wind, training squadrons which operate from various sections of the flying line use the well-regulated "invisible highways" prescribed for each of six wind directions. Cadets and instructors know the type pattern they will fly from the setting of a giant "tee" at one edge of the field. This "tee" is visible for miles and is illuminated at night. A smaller "tee" reveals minor wind shifts for making drift corrections.

On making landings, the pilots make at least two 90° turns with the traffic, which ends up with a landing into the wind and gives the pilot a sweeping view of the surrounding territory.

Pilots are in constant contact with the radio control towers. Night flying is controlled by radio, by lights from hangar roofs and by "biscuit guns." The cadets also are taught to land in narrow alleyways of light on the field.

WASH-OUT

My flying days are over
My helmet's laid away
My wings are clipped close to my sides
My dreams have gone astray
No longer can I . . . like the gull
Soar, dive and fly
No longer can I chase the clouds
Chained to earth . . . am I

How well my mind still visions
My classmates eager, true
They toss their hearts up in the sky
To chase it in the blue
Soaring, climbing, banking, diving
Graceful birdlike things
Oh . . . how I envy those who fly
I wish . . . that I had wings

Yet still I know tis not for me
My niche I haven't found
Perhaps tis written in the book
That I stay on the ground
To keep them flying . . . Planes and men
Must be the job for me
For deep inside . . . I burn with pride
As wings . . . spell victory.

(Written by Pvt. A. R. Petrucci, former aviation cadet; photo by Corp. V. R. Waters. Both are stationed at Goodfellow Field, Texas, AAF basic flying school.)

Shootin' Generals

THE generals in the Army Air Forces Technical Training Command aren't "paper-work" officers. They can shoot.

Brig. Gen. Ralph H. Wooten, commanding general of the Miami Beach schools of the Technical Training Command showed his skill at the opening of the Miami Beach basic training center's new rifle range recently.

General Wooten fired 12 shots with an Enfield rifle at the target and punctured the black circle 11 times. His other shot was less than an inch outside.

Brig. Gen. Junius W. Jones, commanding the First District, AAFTTC, took time out during his recent inspection tour at the Atlantic City, N. J., basic training center to try out the post's new temporary rifle range. General Jones took 10 shots slow fire at a silhouette target with a "Tommy gun" and approximately 10 at full automatic. The target was chewed to bits by his accurate fire.

* * *

New Navy Rating

STUDENT aviators entering the Navy's flight training program have been given a new official designation through President Roosevelt's approval of a congressional enactment.

Heretofore, all who qualified for flight training were enlisted as seamen second class and continued in that rating throughout their primary flight training, a period of approximately three months.

Those who successfully completed primary flight training then were promoted to aviation cadets and sent on to advanced flight training leading to commissions as ensigns, U. S. Naval Reserve, or second lieutenants, U. S. M. C., Res.

The new act provides that student aviators will be enrolled as aviation cadets at the outset and will remain in that designation until qualifying for commissions as officers.

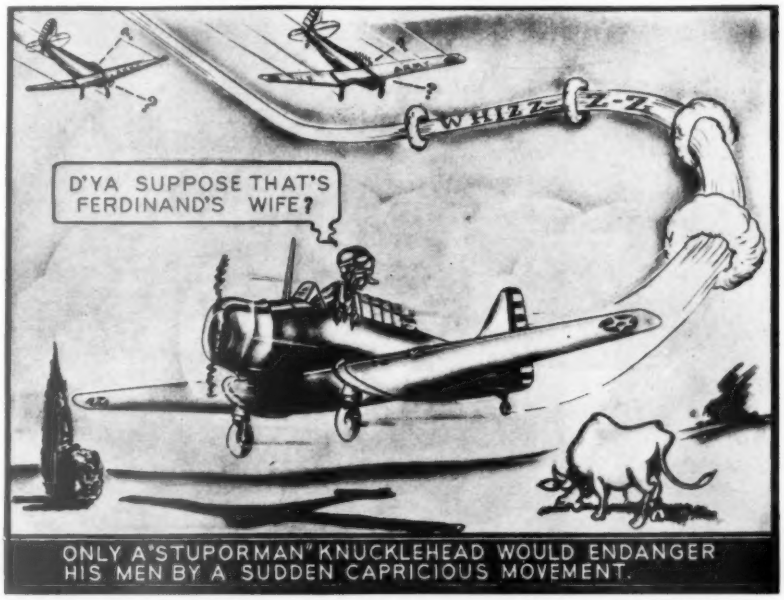
* * *

Gulf Blimp Base

SECRETARY of the Navy Frank Knox has approved the selection of Houma, La., as the site for a new lighter-than-air base.

Construction work is under way, and it is expected that the base will be in operation by spring.

THE AAF'S "CADET KNUCKLEHEAD"


WHIZZ-Z-Z-Z
D'YA SUPPOSE THAT'S FERDINAND'S WIFE?
ONLY A "STUPORMAN" KNUCKLEHEAD WOULD ENDANGER HIS MEN BY A SUDDEN CAPRICIOUS MOVEMENT.

No. 1 in the series of specially prepared drawings used by the Army Air Forces to impress upon aviation cadets the "wrong" way of conducting themselves in air.

Deadly firepower of Bell P-39 "Airacobra" in night action test. Tracers mark .30 and .50 caliber guns, 37 mm. cannon.

HAVE YOU SEEN?

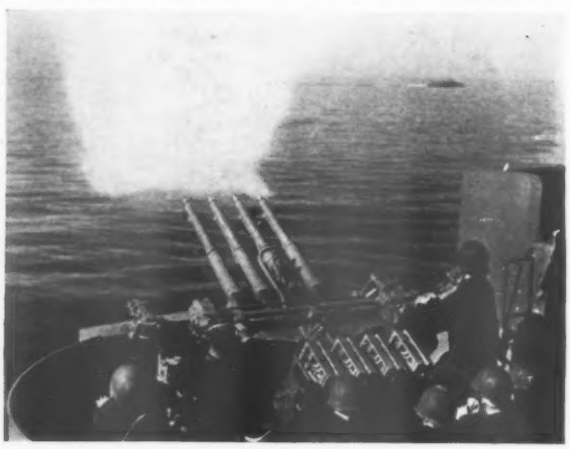
These are the devastating two-ton bombs now used by our air forces. The RAF, meanwhile, already is using four-ton bombs.

The uncanny precision of our bombsight is revealed in this view of bombs from one of our "Flying Fortresses" bursting within confines of Rouen, France, railroad yard. Clouds of smoke mark rail lines, freight sheds and trains cleanly hit.

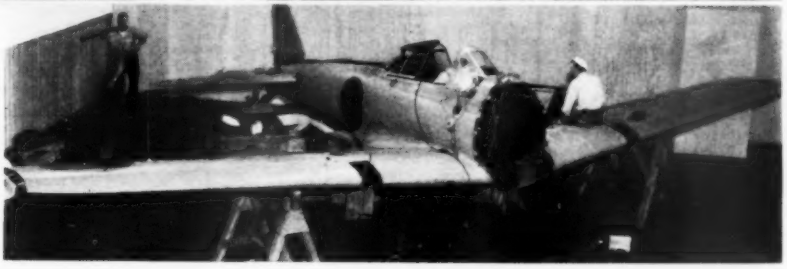
The Vidal-Avro "Anson" trainer. The fuselage, built for RCAF, is largest known molded plywood-plastics structure.

Taylorcraft's glider, designated as the TG-6 by Army, also is known as ST-100, in honor of its sponsor, Charles I. Stanton.

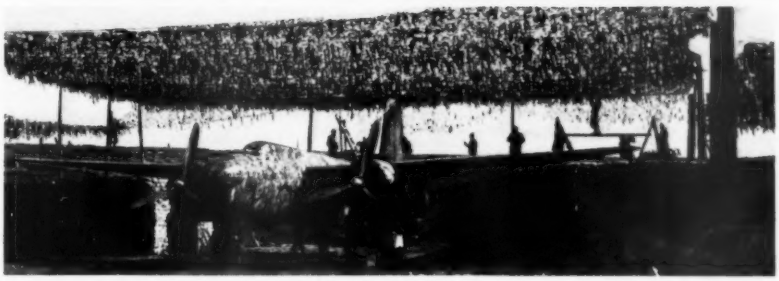
Multiple pom-pom machine gun (known to British as a "Chicago piano") in action on U.S. carrier against low-flying planes.



Naval aircraftsmen at San Diego (right) rebuild captured Jap "Zero" for thorough testing by Navy pilot (above). Engine is 900 h.p. modification of American types.

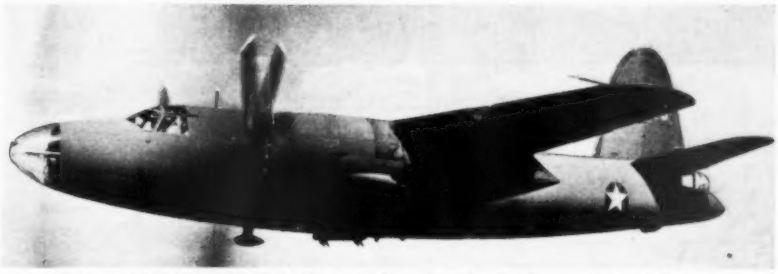


Carried by pilot as seat pack, new type inflatable boat will aid in self-rescue.



Camouflage net of leaves hides Douglas A-20 from enemy eyes. Note sandbag revetments.

"Endless belt" of .50 caliber bullets fire from side of B-17's, ward off fighter craft.



The new Martin B-26B. Note the torpedo rack under fuselage and new tail turret.

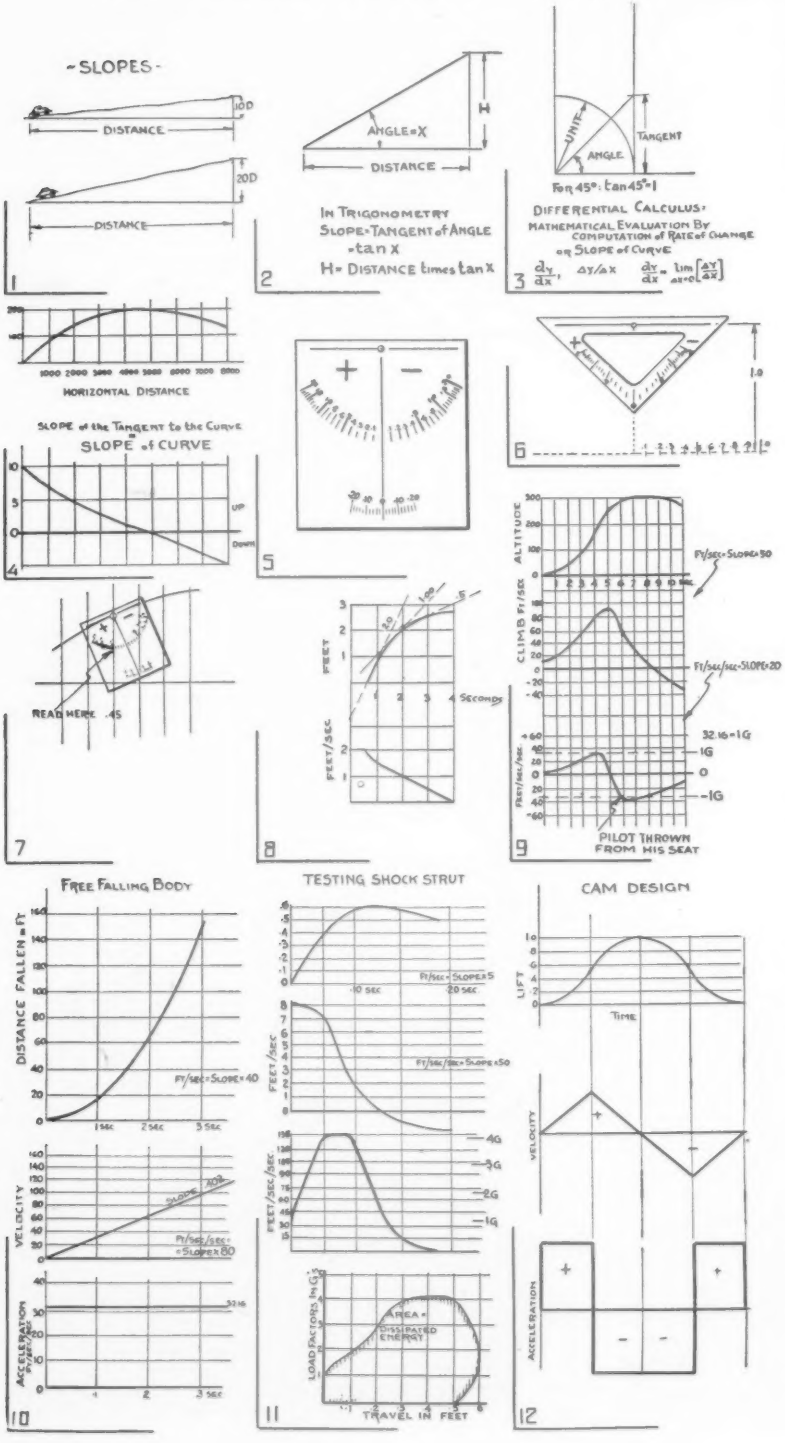
Pilot candidates for carrier duty practice at Perry Field, Fla., in this restricted area. Markers simulate carrier landing deck.

The Nakajima 97 is a Jap version of the French Dewoitine. It is also reminiscent of the old Boeing P-26. Note rare open cockpit.

Graphic Calculus

by RAOUL J. HOFFMAN

Calculus divulges the inner nature of engineering problems and shows where improvement is possible.



ENGINEERING units are designed by calculations or by using data supplied by research laboratories. Usually both are employed in order to reduce the chance of error. In development work, however, mathematics is of greater importance.

Mathematics comprise three main groups; arithmetic, when numbers are always fixed; algebra, when numbers are fixed and variables (x, y . . .) are constant during calculations; and calculus when quantities, ratios or slopes are changing during evaluation. Calculus is divided into two parts reciprocally related to each other: integration and differentiation. Integration evolves the summation of changing quantities, such as areas between a curve and the base line; differentiation computes the change of slopes of two or more variables. Calculus will divulge the inner nature of many engineering problems and indicate where improvements are possible.

In the following differential calculus will be demonstrated by finding the slopes graphically instead of mathematically, thus also getting a visual concept of the problem.

Two roads with different ascending grades are sketched in Section 1. The ratio of the rise and distance is called the slope or incline (usually expressed in per cent of the distance). The upper sketch shows a 10 per cent slope; the lower one a 20 per cent slope. For example if the rise of the road is 400 feet for a distance of 4,000 feet, the slope will be 400/4000 = .10 or 10 per cent.

In trigonometry the slope of an angle is called the tangent of that angle, as indicated in Section 2. Generally, Greek letters (α β) are used for denoting angles. The values of tangents are easily found by the method shown in Section 3. A vertical is drawn to a circle having a unit radius and the circle marked with various angles. A line drawn through the center and the point on the circumference will intersect the vertical. The distance from the intersection to the base is the tangent of the angle. Thus the tangent of 45° will be 1.0. All engineering handbooks carry the values of tangents for any angle. Many signs are used to indicate that differential calculus is to be applied. Some of them are noted in the lower part of Section 3.

In Section 4 the upper sketch shows a portion of a road with its elevations. By finding the slopes of the tangents drawn to the curve another diagram could be drawn to give the slope at each point, thus enabling the driver to know exactly what load he can safety take over that part of his trip. The lower diagram is nothing else than the differentiation of the upper curve.

In differential calculus the equation for the terrain must be known in order to find the equation for the curve of the slopes.

(*Continued on page 116*)

Miss Cornelia Fort

Mrs. Betty Gillies

Mrs. Catherine Slocum

Miss Aline Rhonie

Mrs. Nancy Love

Mrs. Helen M. Clark

The Ladies Join the Air Forces

by ROWLAND CARTER

Veterans of aviation's powder puff derbies come into their own as Army recognizes need of their services by forming an auxiliary ferry squadron.

A FEW months before Pearl Harbor, a high-ranking Army officer is reputed to have brushed aside a proposal for a women's flying auxiliary of the former Air Corps with the impatient exclamation that "we can't have that sort of thing gumming up the defense effort." Circumstances, and perhaps the ideas of the higher-ups, have changed. American women flyers have won their place in the war effort.

It is not a large place, nor very secure, and the Army restrained its enthusiasm in making belated provision to use their talents. The initial quota for the Women's Auxiliary Flying Squadron—immediately abbreviated to WAFS—was only forty pilots. The requirements were set forbiddingly high, and the War Department has stressed repeatedly that the whole subject of employing women to ferry planes within the continental United States was experimental. It is a definite place nevertheless. The WAFS promise to become as important to the Army Air Forces as the WAACS to the ground forces and the WAVES to the Navy.

Any doubt over the bid for equal rights and responsibilities can be put aside provided the caliber of recruits keeps to the top notch level of the pioneers—and the official requirements were aimed at just that objective. In the 12 years she has been flying, pretty Mrs. Nancy Harkness Love of Boston, commander of the WAFS, has done almost everything any woman can do in aviation and knows about ferrying military aircraft from actual experience in delivering to the Canadian border (in pre-war neutrality law days) planes built for the British.

Jacqueline Cochran, who was made director of all women's flying training for the Army, has an even more impressive record, as the first woman to fly an American bombing plane, the first to ferry a bomber across the Atlantic to Britain, holder of five national and international speed records and thrice winner of the Harmon Trophy.

After Mrs. Love, the first pilot to qualify for the WAFS was Mrs. Betty Gillies, of Syosett, N. Y., who had more than 1,400 flying hours to her credit and was one of the handful of her sex with a multi-engine rating. And others of the original group equalled her qualifications in some respects. Of the first 10 accepted, half had flown their own planes for years.

(*Continued on page* 88)

Mrs. Helen Clark, applicant, appears before examining board. At right is Mrs. Nancy Love, WAFS director.

I LEARNED ABOUT FLYING FROM THAT!—NO. 41

by BEVERLY HOWARD

Too much flying in one day dulled this experienced pilot's judgment and led him into a sorry plight.

THURSDAY, September 29, 1938, was one day I never expected to do any flying. As I arose that morning to go out to the airport at Charleston the weather was about as rotten as I had ever seen it. The day before and during the night it had been developing not exactly along the lines of normally unpleasant weather—there was something different in the way the wind blew. Being early in the fall, we always expected to get repercussions of tropical hurricanes along the South Carolina coast. It looked as though this Thursday was going to be one of those stormy days and it seemed certain that flying operations would be nil.

As I ate breakfast I heard what sounded like thunder outside and thought no more about it. But as I drove to the post office I saw that Charleston was a shambles. What had sounded like thunder had been a freak tornado which ripped in five jabs into the city and surrounding area.

The tornado hit Charleston like a gigantic air raid. Every one was dazed and thunderstruck. Nothing like this had ever happened. Buildings, houses, telephone poles were down. The city was a mess. Many had been injured. It developed later that the toll was 30 persons dead, but during the immediate excitement and uncertainty, the death toll seemed higher. A major catastrophe had hit Charleston in no uncertain terms.

It didn't take the press long to get on the job, for immediately after the wind had done its damage to the city, pho-

The author's Waco after the crackup. He was able to salvage $15 worth of parts.

tographers and reporters rushed to the airport to charter planes for photographs of the carnage. The weather was still bad. I felt that it would be foolish to risk my equipment under the circumstances. The ceiling was still below the 500 foot mark, the rain was driving down

Now president of Hawthorne Flying Service, Howard is a noted lightplane stunt flyer.

in intermittent torrents and while the main force of the devastating wind had rolled by, it was still gusty, reaching at times 40 m.p.h. on the airport anemometer.

I finally agreed to fly photographers, although I couldn't see how they could get anything with the weather the way it was. I knew the plane would be bouncing so badly that it would be almost impossible to get anything but a blurred picture. But they were paying for it, and paying plenty, so urgent was their mission. I had the mechanics roll out my newly acquired Waco taper wing, which I figured would be best under the high wind conditions. The ship was my pride and joy, all red and fancily painted and with a 225 h.p. Wright J-5. I had bought it primarily for acrobatic purposes and had been using it at air shows throughout the south that summer.

The beaches had been hit as well as the city, hence it was necessary to fly 10 miles or so to the ocean to get pictures of the damage wrought there. The ceiling was going up and down varying from 300 to 1,000 feet with intermittent rain. But it was about as rough as I had ever seen it. After a little more than four hours of steady flying, I found I was getting terri-

(*Continued on page 98*)

"Grasshoppers"

by Kurt Rand

THE Army is casting about within the ranks of the ground forces to find more onetime civilian pilots to fly lightplanes for the field artillery's "grasshopper" air force. The civilian training program of the Civil Aeronautics Administration, fully geared now to meet military needs, has started supplying candidates for advanced training as spotters of artillery gunfire on the battlefield. But officials suspect a substantial number of men in the ground forces who retain an urge to fly are still available for transfer to the new "grasshopper" force.

Early in the war the CAA made a survey of its pilot training graduates who were in the armed services and found that some 8,000 were doing military jobs other than flying. A large proportion was kept out of combat flying for the Army Air Forces by age, eyesight or other disabilities. Many of course have since responded to the appeal for glider pilots.

The transfer from the ground forces is reported to be relatively simple to effect by means of an application to one's commanding officer. Those accepted, after their qualifications have been passed upon and approved, are sent to the field artillery center at Fort Sill, Okla., for advanced schooling in how to take a plane up to a few hundred feet from a cow pasture and bring it down in a hurry, and to direct artillery fire in the process. If the flyer has had prior military experience, five weeks' advanced training suffices, while 10 weeks is required of others.

In announcing plans to expand the "grasshopper" force, the War Department stipulated:

Pilots will be chosen from among officers of the grade of captain or lower, and from enlisted men, all of whom hold, or have held, CAA ratings as private pilot or higher.

Applications for pilot training will be made available to all qualified ground forces personnel. Pilot applicants are required to furnish all information available regarding their flying experience, the numbers of hours flown in planes over and under 80 h.p., the amount of solo flying time in cross-country and night flying, and any other pertinent facts.

Knowledge of flight instruments also is tested and applicants are questioned as to civilian occupations which might add to their qualifications as a pilot.

Applicants who have received pilot training under the CAA must state when the course was completed and the names of the flight instruction contractors.

Pilots who successfully take the Fort Sill course will wear wings and receive flying pay. Enlisted pilots will hold the grade of staff sergeant, and officials reported there would be ample opportunities to win commissions.

These liberal requirements opened a colorful new branch of military aviation to flying enthusiasts who hitherto had despaired of piloting fast fighters and

(*Continued on page 147*)

AMERICA NEEDS PILOTS!

Learning to fly is one of the finest ways in which you can help your country and yourself! America needs pilots NOW to help win the war . . . and she needs them for the future to carry on the great aviation industry that peace will bring.

Prepare yourself for a place in military aviation by learning to fly today! Take your instruction in the famous Piper Cub Trainer . . . the plane in which thousands of Uncle Sam's pilots received their initial instruction . . . the plane that is daily starting eager fledglings on the way toward winning their wings in our armed forces.

Flying is a not a skill reserved for the chosen few. Whether you are sixteen or sixty . . . if you are in normal health and possess normal judgment . . . you can learn to fly with as little as eight hours of dual instruction in a Piper Cub!

Contact your Piper Dealer . . . ask him for a flight demonstration. Get started on a career in aviation . . . a career that will help your country now and offer unlimited opportunities for your future.

FREE BOOKLET ON HOW TO FLY. Send today for your copy of the easy-to-understand booklet "You, Too, Can Fly!" If you also want the full-color Piper catalog, enclose 10c in stamps or coin for postage-handling. Piper Aircraft Corporation, Dept. PA122, Lock Haven, Penna., U.S.A.

PIPER POINTS THE WAY TO WINGS FOR ALL AMERICA

The Trusty 'OX'

(*Continued from page 57*)

Glenn L. Curtiss product that was designed and built in Curtiss' original war plant in Hammondsport, N. Y. It can safely be said that the development of the Curtiss motors from the original one cylinder, three horsepower gadget was one of the chief contributing factors in the development of aviation. Until very recently there were more OX-powered ships on civil airports than any other motor. OX's were standard equipment in Fairchilds, Wacos, Birds, Travelairs, Swallows, Curtiss JNs and many other early ships. You'll still find OX's on most airports that don't frown on the poor man's flying.

The OX is kin to the original Curtiss E4, four cylinder, water-cooled 50 h.p. motor that startled the few flyers of the time with its original battery ignition. The E4 changed to the E8 which was the same motor with eight cylinders instead of four. The E8 was the first "vee" type combustion motor in production. Incidentally, the battery ignition was given up about that time for the more dependable magneto ignition. The Curtiss E8 gave way to the Curtiss "L" with its smaller bore—four inch bore, five inch stroke. The Curtiss "O" is a refined Curtiss "L".

Then came the war and the 1917 version of mass production. Curtiss took his "O" model and changed it here and there and gave the army the Allison of the last war—the Curtiss OX-5. The OX series continued with various improvements; the "O-double-X" with double ignition, then 12-cylinder affairs which were used in the original multi-motored transports.

War production was the first order of the day in the last war as it is in this war. After the War Department okayed the OX-5 for mass production, Curtiss sublet the designs to other manufacturers, who then made the same motor. That's why you'll occasionally find an OX with a different manufacturer's release on it.

The story of the *Jenny* is the story of the OX in the last war. The *Jenny* (Curtiss JN) with an OX-5 in it was by far the most popular plane among the training ships of the last war. Most all British, Canadian and American flyers were trained in ships with OX's in them.

The OX was the power plant of the developers of aviation—the mainstay of barnstormers, the university of instructors. The Army Air Corps of today would not be the same if instructors had not had such valuable time with OX's. That is why it's the OX against the Axis powers in this war. It's the skill, the ingenuity, the experience of American pilots with OX's that may turn the tide against the enemy.

After the first World War was won, warehouses were packed to the rafters with OX-5's because the manufacturers had out-produced the makers of aircraft. As discharged flyers came back from France, a number of them bought OX's from the Government for a few dollars. They took them home and built themselves an airplane. This was, of course, before the days the Government began to worry about such things. As late as 1929, aircraft manufacturers were still buying OX's from warehouses and sticking them in their new designs.

An ex-Army flyer would get himself an OX, build a plane, fly the ears off it and then sell it in favor of a factory-designed, factory-built plane. Strangely enough, his factory would probably have an old reliable OX in it. Friend taught friend, fields were rented, hangars built, runways laid, but the blood never ran cold in the OX's.

"Well, for one thing . . . it ain't Major Lee!"

There were enough OX's in use at the time to encourage manufacturers to produce improved parts that took some of the kinks out of the original motor. Miller introduced his modern overhead assemblies with the one shot lubrication and it wasn't long before pilots were bragging that they had a "Miller OX." The Tank brothers redesigned the motor a little, took off the parasitic water-cooling system and called their new product a Tank motor. They advertised a trade-in offer that was original with them but has since been adapted by many others including leading automobile manufacturers. "Trade in your OX for a rebuilt, redesigned Tank" was their suggestion.

Those that fear the OX, fear themselves as pilots. Anyone who speaks disrespectfully of an OX has not had much time in one, and is usually a young flyer who was brought up in the "lightplane age."

To many pilots an OX today is reliable, dependable and as safe (as well as more economical) as a modern motor. It's old, it's weighty, it's dirty, it's lost its luster, it smokes but it still is a swell motor.

When comparing the Curtiss OX-5 with modern motors, one must speak either in generalities or statistics. Generalities serve the same purpose, but in a more interesting and easy way, so let's skip engineers' hum-drum tolerances and confine the comparisons to generalities.

The OX-5 is the most economical motor to operate when you consider gas consumption and horsepower. An average OX will burn between five and six gallons of automobile gasoline (which retails at 18c) and turn out 90 h.p. The average lightplane motor will burn from four to five gallons of aviation fuel (retailing at 25c per gallon) and turn up from 38 to 65 h.p. The cost is approximately the same (slightly in favor of the OX), but the horsepower is overwhelmingly in favor of the OX. Your lightplane is designed as a two-seater with a moderate baggage allowance while most OX powered ships are three-place jobs with plenty of baggage space.

The OX-5 with full throttle delivers about 1,400 r.p.m. on the ground, while the average lightplane delivers something in excess of 2,400 r.p.m. on the ground. An OX *Challenger*, for instance, will cruise comfortably at 85 to 90 m.p.h. while turning up 1,100 to 1,200 r.p.m. the lightplane with its smaller prop wants up to 1,700 r.p.m. (and over) to sustain flight and cruise at 75 to 80 m.p.h.

An OX can be "souped up" to turn up more and increase the horsepower, but because this changes the manufacturer's design, a license will not be issued except under "X" conditions. Crop-dusters do this. By removing the carburetor from the rear and under side of the motor to an overhead forward position, the horsepower can be increased from 90 h.p. to as much as 140 h.p. with comparatively little increase in gas consumption. Fire hazards present themselves with this change, however, and extreme precautions must be taken.

There are many disadvantages of the OX that have been ironed out in the newer motors. Weight, for instance. The modern motor turning out 90 h.p. is embarrassingly lighter than the OX. Too, the OX has water-cooling equipment which is a definite disadvantage to performance.

Although the 'vee' in-line cylinder ar-

Maybe he's *your* boy

IT seems only yesterday he was a gawky schoolboy, all hands and feet and tousled hair.

Even then you worried a little, parent-like, about how fast he drove his battered jollopy.

Now he's flying—or soon will be—the deadliest weapon in the air, a sleek 400-mile-per-hour fighter.

Or perhaps his battle station is the bombardier's "barber chair," or the tail-gunner's "goldfish bowl" in a giant bomber, or at the controls of a U-boat-hunting blimp.

Whatever his duty, more than your fears and your prayers fly with him—all your hopes, all your dreams for him and for your country ride in that aircraft, too.

What cost of effort or zeal or self-denial is too great—if it will give him the finest plane, the safest equipment in the air?

We feel the same way about it here at Goodyear Aircraft. Many of our men and women have sons, or brothers, or husbands, in the air forces, too.

And beyond this there is the sober knowledge, clear now to all Americans, that our cherished liberty, our standard of living cannot be secure again until this nation wins command of the air—and it is these boys who must win it for us.

It is for them, your lad and ours, that Goodyear aircrafters—welders and riveters, pressmen and foremen, engineers and executives together—are striving with all the skill and ingenuity of long aeronautical experience to help build the safest, sturdiest airplanes and airships modern engineering can create.

It is to give them mastery of the skies that we are working in round-the-clock shifts, seven days a week, to produce our full share of the airplane subassemblies—wings, tails, control surfaces, cabin units, wheels, brakes and other parts—for the 60,000 airplanes America must have this year.

In this we are working with and for the manufacturers of some of America's most famous battleplanes, both fighters and bombers, that are proving their superiority on all fronts.

If your boy is flying one of them, you can be sure his craft is as staunch and airworthy as scores of great American industries cooperating together can make it.

For these boys, yours and ours, are the hope of America, the guardians of the greatest heritage ever given to any people. They will not fail us, nor we them.

HOW GOODYEAR AIRCRAFT CORPORATION SERVES THE AIRPLANE INDUSTRY

1. *By building parts to manufacturers' specifications.*

2. *By designing parts for all types of planes.*

3. *By re-engineering parts for mass production.*

4. *By extending our research facilities to aid the solution of any design or construction problem.*

rangement tends to create less profile drag, this is offset by the monstrosities in the form of radiators that usually lie flat against the wind and create blind spots which are eliminated by the modern aircooled motor.

In 1918, when OX-s were designed, eight cylinders were needed to do what modern motor designers can now do with six and four cylinders. There are several manufacturers of lightplane motors who put out a two-cylinder engine which is capable of delivering as much as 50 h.p.

Try to pin the pilot who dislikes OX-s down to a specific reason for this dislike and it's like trying to start a motor with the switch off. Certainly OX-s have let many flyers down. What motor hasn't? But is it the motor or is it the pilot?

I know one chap who bought an OX powered Fairchild *Challenger* several years ago and has been squawking about it ever since. Three months after he bought it he sold it at a big loss. The fellow who bought it from him had more than 250 hours in it without a bit of trouble. The first owner had three forced landings in three months—the second owner had no forced landings in over a year. What's the answer? It's the same motor—the only difference is the pilot.

An OX isn't temperamental, nor fussy, nor dangerous, but it is an old motor. Mind you, the OX-s that are still flying today were built in 1917-18. If you take proper care of your OX—just as any other motor must be cared for—you should never have trouble.

Instead of a periodic, hasty 20 hour check, give it a flight check on some of the trouble spots. The overheads need fresh grease and oil frequently. The wells need draining *every* time you fly. Keep the mag in good shape, never let it get wet. Have it tested regularly and you'll have no trouble from that score. Don't depend on your partner keeping your OX healthy—you'll have to get your hands dirty and do it yourself if you want enjoyable, carefree flying.

To get back to the different owners. The first owner flew it for about 25 hours. His only obligation, he thought, was to feed it aviation gas and keep it well supplied with oil. He forgot the overheads, the valves, the carburetor and all the other little things that take only a few minutes to check each flying day, but which make an OX a lot of fun. The second owner had respect for old age and thereby got a lot of inexpensive flying on his motor with no trouble.

An OX doesn't want high test aviation gas. Remember they were built before gasoline companies knew the difference between "octane" and "ethyl." High test gas brings on valve troubles. Regular old fashioned automobile gas from the corner gas station is the best known fuel for an OX.

The next time you get a few minutes to yourself try to remember when you last saw a 1925 automobile in good running condition. A long time. Now take a mental trip to the three nearest airports and see how many OX powered ships are there—still flying on their merry way. You'll find they are still plentiful, and the OX-s were built almost 25 years ago.

Now for stamina. The OX-s have a habit—so the fearful say—of letting you down. It's the definitely biased opinion of the writer that an OX-5, if properly cared for, will run hour for hour with some of the most modern stock model motors. More care must be taken and minor adjustments must be considered, but all in all, the things that will let an OX down are the identical things that will let any motor down.

Ignition wires will break in an OX just as they will break in an Allison; a carburetor in an Allison over Egypt might get dirty just as an OX carburetor might get dirty over Atlantic City.

Joe Campbell, a Philadelphia policeman, who has more than 800 OX hours logged, was flying a Fairchild KR31 *Challenger* with an OX in it to Atlantic City one Sunday afternoon. He had his wife and baby daughter in the front cockpit. The route to Atlantic City from Philadelphia is over a 20-square-mile patch of three foot dwarfed pine trees and is just about the worst place in the world to effect forced landing without danger to the occupants or damage to the ship. Joe was flying at about 1,500 feet about midway in the pine growth when the entire left bank of the OX quit on him. Although four opposing cylinders were as cold as tomatoes, the remaining four carried him safely to an emergency landing at an airport. He was still flying at 600 feet 20 minutes later and had traveled more than 25 miles at an expense of less than 1,000 feet of altitude. A master ignition cable had snapped and cut out the one side of the motor. Try to fly *your* motor on half its cylinders and see what happens.

In all his 800 OX hours, Joe has had four forced landings with OX powered ships but on three of these he was able to trace the trouble to a common motor failure that could have happened to any motor. One time, his water jacket got loose and he cut the switch rather than burn up the motor. That, naturally, wouldn't happen on an aircooled motor, but it was the only one of four forced landings that was individually OX.

OX-ers are a little different than most pilots—they are a little *more* than ordinary pilots. It's the old timer's equipment handed down to this younger generation, and the younger generation flying an OX powered plane today are learning lots more about flying than they realize. An OX-er with 100 hours is a much better flyer than a pilot with a comparable number of hours in equal horsepower ships. Don't take my word—ask any Army instructor. Ask any old timer—they'll tell you the story.

An OX-er, to be sure, is not a dude. Standard equipment of an OX is a pair of dirty overalls and a can of grease solvent. Ten minutes around the OX—that is if you want to keep your motor right—is like 10 hours under an auto-

(*Continued on page* 139)

"No Other Airplane So Well Suited for Instrument Work"

Reed Pigman, president of American Flyers, who owns and continuously operates several REARWIN INSTRUMENT TRAINERS, says:

"The excellent visibility due to tandem arrangement, the ease of handling and low cost of operation make the REARWIN INSTRUMENT TRAINER the finest available in any price class.

"Our first REARWIN INSTRUMENT TRAINER has in excess of 1000 hours with less than $5 spent for repairs. We recently overhauled another of our REARWINS after 600 hours of nearly continuous use (18 hours some days) and there were no signs of undue wear other than rings, valve guides, etc.

"Our newest REARWIN INSTRUMENT TRAINER has over 100 hours and it is giving us the same carefree operation as the others."

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A-Ts ?

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Pilots of the Lycoming-powered Cessna AT-8 Advanced Trainers (above) become familiar with multi-engine operation and express profound faith in the reliability of the Lycoming power plants, that are paving the way to victory!

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THE TRAINING PLANE ENGINE OF TODAY... THE PRIVATE PLANE ENGINE OF TOMORROW

LYCOMING DIVISION, THE AVIATION CORPORATION WILLIAMSPORT, PA.

Look at the Record!

(*Continued from page 25*)

". . . *Kittyhawks* have recently taken a large part in the smashing British counteroffensive which brought the Axis drive on Alexandria to a halt. The *Kittyhawks*, equipped with bomb-racks, have become '*Kittybombers*' and, as such, are being used both against Nazi tanks and mechanized equipment and against Nazi aircraft, with great success in both cases.

"The *Kittybomber* . . . is fast enough to take on any fighter built, even with bombs in the racks. As bombers they are not as vulnerable as the *Stukas* . . .

"In one of their first forays as fighter-bombers, a formation of *Kittyhawks* flown by Australian pilots was attacked by a formation of 10 Messerschmitts. The *Kittybombers* went into a twisting dogfight with bombs still in the racks, shot down two of the Messerschmitts, drove off the others, and then went on with the bombing attack. . . .

". . . a British air observer at Cairo has reported that on May 18, eight P-40's *(Kittyhawks)* and four British *Beaufighters* intercepted 20 Ju-52's (transport planes), escorted by three German Messerschmitt Me-110 two-engined fighters. The P-40's accounted for seven of the transport planes and two of the Messerschmitts . . .

"Another report . . . relates that in offensive patrol and bomber escort operations in the Libyan battle area, 690 sorties were undertaken by *Kittyhawks* and 173 by *Tomahawks*. In addition to attacking motor transport and military targets they destroyed German aircraft as follows: 90 on the ground; nine in the air, certain; two in the air, probable; 10 in the air, damaged. British losses during this whole period were 16 aircraft destroyed and one damaged.

". . . A flight of 12 *Tomahawks* in the Near East encountered a mixed German and Italian force of more than 60 planes. Fighting at odds of better than five-to-one, they destroyed 36 of the enemy planes.

". . . The first *Tomahawk* (in Russia) went out alone, with a Major Pilyutov, a fighter pilot, at the controls. He was attacked by six German Heinkels. Fighting against these odds, Major Pilyutov downed one Heinkel and drove off the others.

" 'The *Tomahawks* are making a good showing during the present spring season, too,' it is reported in another Russian account received in this country. 'On April 1 they bagged eight German planes on Leningrad front. On April 13, three *Tomahawks*, under command of Senior Lieutenant Zelenov, shot down five Fascist planes during one engagement. Since the day when *Tomahawks* first appeared on Leningrad front five flyers—Pilyutov, Pokryshev, Flotov, Zelenov and Fedorenko—shot down 50 German planes.'

". . . In the Southwest Pacific, early and less effective models of the P-40 have acquitted themselves splendidly. On February 9, a formation of 16 P-40's intercepted 25 Japanese heavy bombers escorted by two fighters over Soerabaja. They destroyed five bombers and one of the fighters. One American plane was shot down, but the pilot parachuted to safety.

"In another encounter, seven Army P-40's encountered a formation of nine enemy bombers escorted by 14 Jap fighters. The Americans shot down one of the bombers and one of the fighters, damaged four other bombers and two fighters, and forced the entire formation to turn back; a decisive victory at odds of 7-to-23.

". . . General Stilwell reports that . . . on July 30, 27 Zeros attacked Hengyang. They were met by American fighters, which shot down four Japs without any loss to themselves. On the following day 35 Zeros repeated the attack. They were engaged by 13 P-40's and the American pilots shot down six Japanese planes, destruction of which was confirmed. It is believed that three others were shot down. No United States planes or pilots were lost in either of these engagements.

"Brig. Gen. Claire L. Chennault . . . has been quoted in news reports from Chungking as declaring that the new Zeros, of which 15 have been shot down over Hengyang, 'are better than the old ones, but inferior to our planes, and it will take at least two years before the Japs are able to construct anything equaling our newest.'

"Other American fighter planes which have revealed superior qualities in actual battle are the Bell P-39, or *Airacobra*, and the North American P-51, or *Mustang*.

"These planes, like the P-40, are medium-altitude fighters. While designed for maximum effectiveness at altitudes of about three miles, they have been defeating enemy fighters and bombers up to a height of five miles, far above the range for which they were intended.

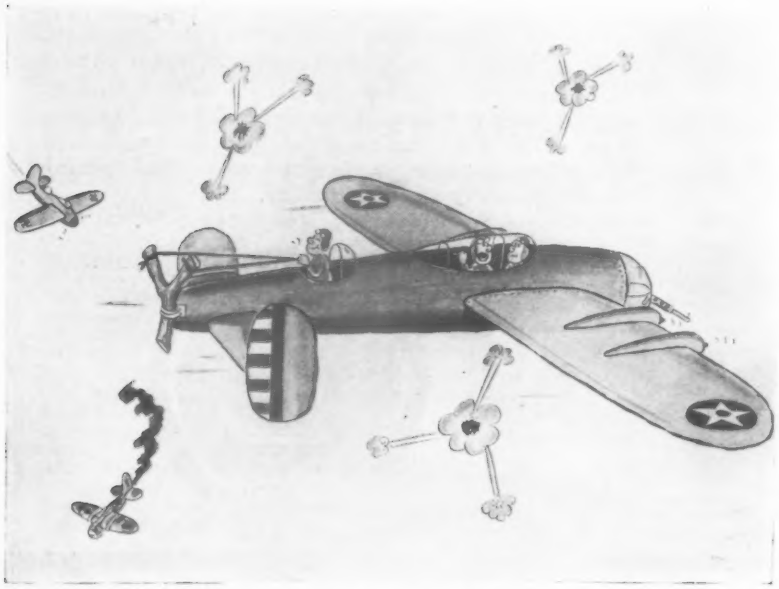
"A report from Russia has stated that a squadron of P-39's engaged and destroyed 73 German airplanes with the phenomenally small loss of only two planes. All types of German aircraft are reluctant to close with these fast, deadly, cannon-firing fighters, the report declared . . .

"There have been many encounters in the Southwest Pacific area between our fighters and the Japanese Zero fighters. Maj. Gen. George H. Brett states that when our fighter pilots are asked if they would trade their P-39's and P-40's for the Japanese Zero, their answer is definitely and almost unanimously in the negative. Such a trade would mean giving up the protection of armor, leakproof gasoline tanks, and parachutes, they reply.

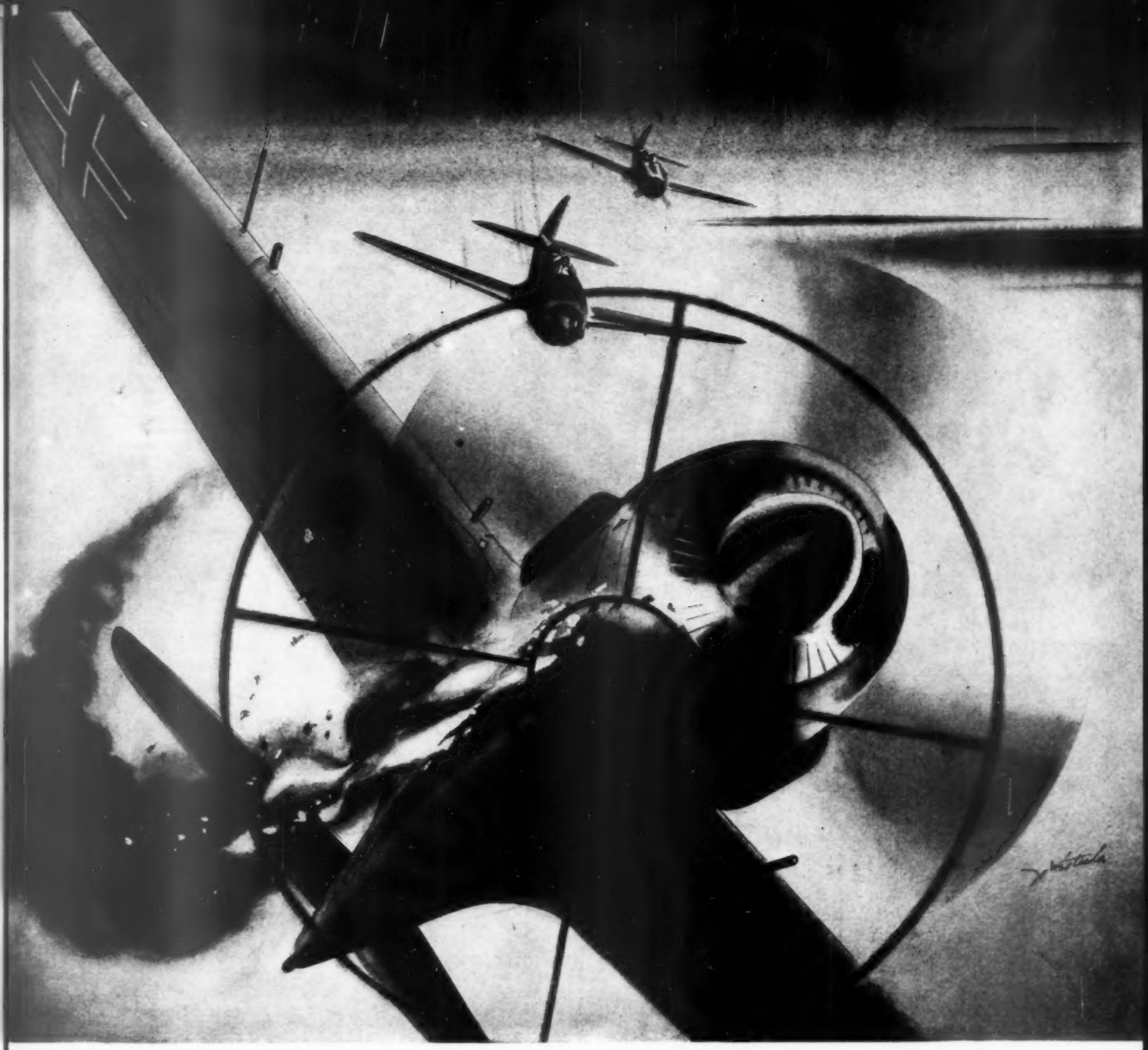
"Recently it was announced officially from London by the Royal Air Force that the new North American P-51 *Mustang* fighter, recently put into combat operation by the Army Co-operation Command, has given a splendid account of itself in action over the invasion coast. Until they are needed for close army support, the P-51's are being employed as Fighter Command aircraft by the RAF . . .

"American-made fighter planes designed especially for high-altitude combat are now in service or are now being delivered to far-flung battle fronts, but reports on their performance are still too sketchy for public announcement. The Lockheed P-38, or *Lightning*, however, has already engaged the Japanese with notable success . . .

"Another Army Air Forces high-



"He does pretty good with it, too!"



THIS WAY OUT!

Crossing the ringsight of a Browning is the last act for many an Axis pilot! ☆ ☆ ☆ In today's theater of war, American marksmanship and American planes are more and more playing their vital role, in the swing to ultimate victory. ☆ ☆ ☆ Aeronca is proud of its contribution to the "all out" offensive by making training planes for the United States Armed Forces strictly to its own exacting standards of First and Finest. ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆

Aeronca Aircraft Corporation, Middletown, Ohio

AERONCA

The Aeronca Victory Award

The Aeronca Aircraft Corporation pledges its entire resources of equipment and experience to produce only the finest in material and manufacture for the men who are privileged to fly for their country. ☆ ☆ ☆ The — Aeronca Victory Awards — presented to employees for skill that develops better products or creates time-saving operations— are its dedication of an "all out" pledge to win the war in the shortest space of time.

AERONCA

TODAY'S Harley-Davidson Motorcycles are duplicating the splendid record made by their predecessors back in World War I. The hard-riding scouts who lead the advance of armored divisions to reconnoiter, spot mines, traps and ambushes, report on road conditions and enemy movements, know that the staunch and sturdy construction of their mounts will not let them down. They know, as thousands of civilian riders know that in Harley-Davidsons dependability is an inbuilt quality that makes them equal to any task assigned to them.

See your Harley-Davidson dealer. While there are no new Harley-Davidsons available now for civilian use, he may have some good values in reconditioned models.

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altitude fighter—the Republic P-47, or *Thunderbolt*—now is in production and ready for delivery to combat theaters. This plane is regarded as a tremendous package of power and is believed able to outfly and outfight any other known airplane . . . Moreover, it is built not only to give but take rough treatment, weighing some 11,000 pounds as compared with 6,000 of ordinary pursuits or fighters, most of the weight being in armor, armament, supercharger and equipment for high-altitude flying. Definitely in the 400 m.p.h. class, it will be at its fastest between 25,000 and 30,000 feet.

"American bombing planes have established themselves as superior to anything thus far shown by the enemy. The Boeing B-17, or *Flying Fortress*, has gained world fame in the present war. The Consolidated B-24 *(Liberator)* also has made an impressive reputation in all parts of the world. The smaller, agile Douglas A-20 attack bomber, known to the British as the *Boston* and, in a night-fighter version, as the *Havoc*, also has performed notably. The North American B-25, in which General Doolittle raided Tokyo, and the Martin B-26, a fast bomber which has 'doubled in brass' by carrying torpedoes at Midway and in the Aleutians, are other bright stars in the galaxy of American bombers. The Lockheed *Hudson*, built for the British, has been an outstanding performer since the start of its long career.

"Here are a few typical actions in which B-17's were engaged:

"On July 25, at Buna, New Guinea, one B-17 was engaged by 15 Japanese Zero fighters. The B-17 was slightly damaged. Enemy losses, one zero shot down and two others probably shot down.

"On July 17, at Tulagi, one B-17 was engaged by three Zeros. The B-17 was not damaged. One enemy plane was shot down and one was left burning.

"On July 19, in the Rabaul area, five B-17's were engaged by 10 Zeros. None of the American ships were damaged but one Jap was shot down and two possibly shot down.

"There are the well-known examples of Captain Wheless, whose aerial gunners fought off a sustained attack by a squadron of Zeros during a running fight of more than 75 miles; and Captain Sharp, whose crew fought 23 Jap Zeros for two hours over Burma, destroying at least four of them before being forced down.

"The British have called the B-24 *Liberator* bomber one of the finest military aircraft yet produced. While it is true that the bomb loads carried by the B-17 and B-24 bombers are less than those which can be carried by the new British four-engine bombers, their range is far greater. The American bombers were built with an eye to vast distances while the British ships were designed for and have been used in the European war, almost exclusively, with the German industrial centers as their principal targets. The American bombers also have been designed for daylight bombing of specific military targets—a mission which demands greater speed and gun-power than any type of night bombing. . . .

"In the B-25 and B-26, the United States has a pair of medium bombers that definitely outclass anything in the world. They carry about two tons of bombs at speeds of over 300 miles per hour and are very heavily armed.

"Other United States medium bombers, such as the Lockheed *Hudson* and *Ventura* and the Martin *Maryland* and *Baltimore*, have been going to the British and have been used with very great success . . .

"The B-26 is regarded as a very advanced type. Reports from the Japanese theater show that it has speed and firing power enough to make it self-sufficient and that it can conduct raids over heavily protected enemy territory without fighter protection.

"At Lae, New Guinea, on July 4, 10 B-26's were intercepted by 15 Zero fighters. Four Zeros were shot down and one more probably shot down. Four of the B-26's were damaged but returned. One B-26 was lost by having the wing knocked off by a falling Zero that had been shot down by another B-26 . . .

"One of the war's most striking examples of versatility and all-around efficiency has been provided by the Douglas A-20 two-engine attack bomber. The British have used it as its American designers intended originally that it should be used—as a tree-top attack plane. The latest plane of this model, the Boston III or A-20C, carries a heavier bomb load and is considerably faster than the RAF's principal attack bomber, the *Blenheim*, we are informed.

"It was with this airplane that American Army Air Forces pilots, on July 4, made the first AAF raid on the European continent. One of the group, Maj. Charles C. Kegelman, was forced down on the DeKooy airdrome in Holland with one motor shot apart, the tail assembly riddled with bullets and other damage. He caromed off the runway at 275 m.p.h., tearing a gaping hole in the fuselage, but got the ship back into the air, blasting two antiaircraft towers at the edge of the field as he did so, and came home safely.

"Recent sorties by the *Bostons* in Northern France have included 16 against power stations, 10 against German airdromes in occupied countries, and 26 against industrial targets. In these 52 raids, in spite of the concentrated antiaircraft defenses and German fighter protection in the areas raided, only one *Boston* failed to return. . . ."

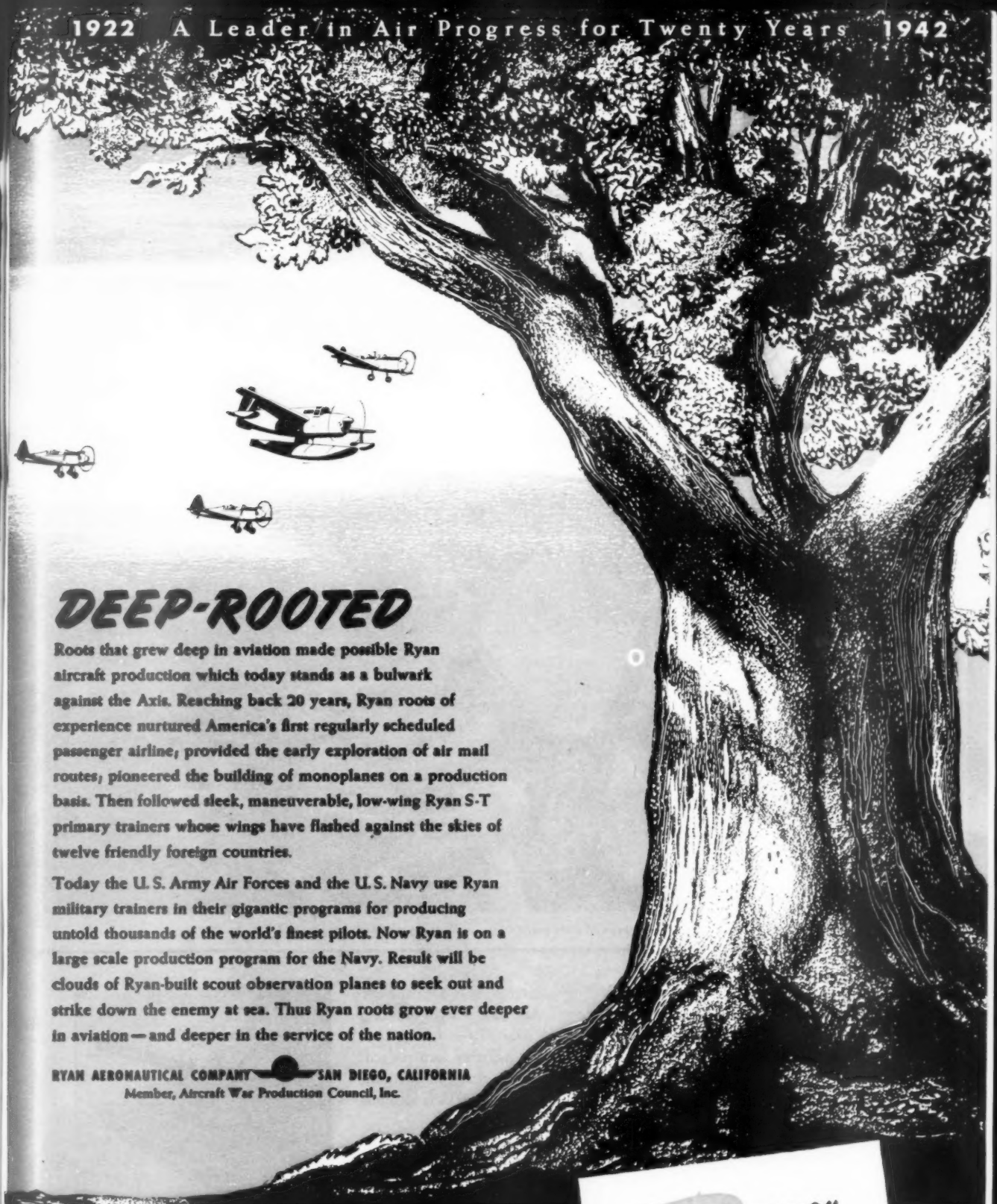
Such was the report by General Arnold. There were other examples, adding to the evidence that in general, American planes are at least as good as enemy aircraft, and class-for-class are better.

And to his written report, he added a verbal postscript: In the Pacific, 1,010 Army planes met 1,549 Japanese planes; the Army lost 104, the Japs 190. That did *not* include the performance of General Chennault's AVG Flying Tigers, who destroyed 218 Japs with a loss of 84 of their own planes.

That is the score, and the score is the proof.

END

1922 A Leader in Air Progress for Twenty Years 1942

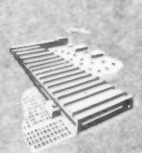


DEEP-ROOTED

Roots that grew deep in aviation made possible Ryan aircraft production which today stands as a bulwark against the Axis. Reaching back 20 years, Ryan roots of experience nurtured America's first regularly scheduled passenger airline; provided the early exploration of air mail routes; pioneered the building of monoplanes on a production basis. Then followed sleek, maneuverable, low-wing Ryan S-T primary trainers whose wings have flashed against the skies of twelve friendly foreign countries.

Today the U. S. Army Air Forces and the U. S. Navy use Ryan military trainers in their gigantic programs for producing untold thousands of the world's finest pilots. Now Ryan is on a large scale production program for the Navy. Result will be clouds of Ryan-built scout observation planes to seek out and strike down the enemy at sea. Thus Ryan roots grow ever deeper in aviation—and deeper in the service of the nation.

RYAN AERONAUTICAL COMPANY — SAN DIEGO, CALIFORNIA
Member, Aircraft War Production Council, Inc.

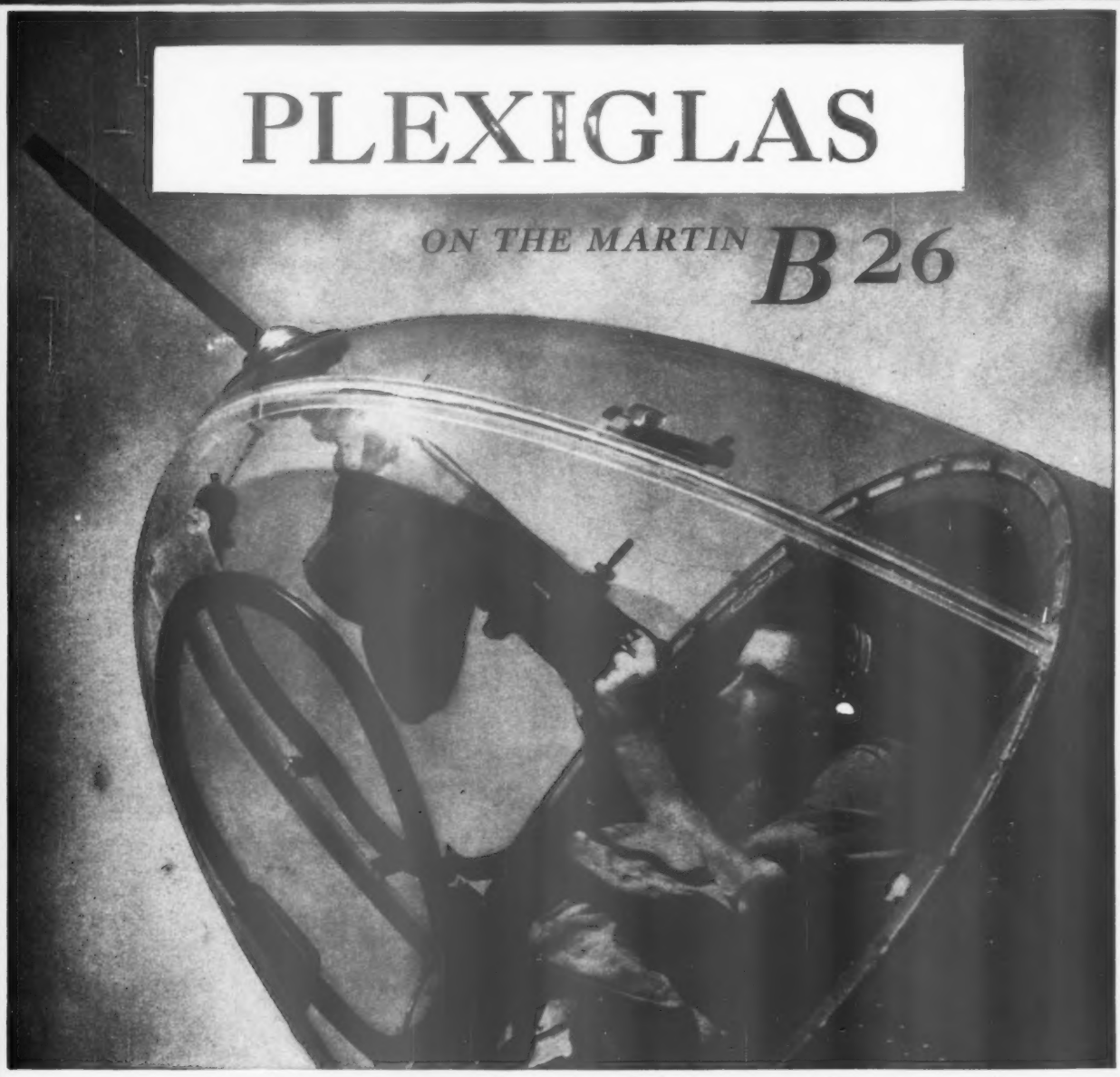


The modern Ryan factory provides every facility for producing all types of advanced military aircraft. Ryan engineering and development set highest standards. The Ryan Exhaust Systems Manufacturing Division has perfected flow production of manifolds.

RELY ON Ryan
A NAME OF MILITARY SIGNIFICANCE

PLEXIGLAS

ON THE MARTIN B-26



On the B-26, as on every type of Army and Navy airplane, you find clear, rugged PLEXIGLAS

AIRPLANE gunners are always looking for trouble! That's why crystal-clear, transparent PLEXIGLAS is used for the nose on the Martin B-26 —and on every other type of American bomber. PLEXIGLAS tail enclosures, gun turrets, cockpit enclosures, observation domes, side windows and landing light covers likewise, are seeing action aboard every type of Army and Navy aircraft.

You see, PLEXIGLAS is permanently transparent. It's clearer than ordinary glass . . . yet only half as heavy. It is easy to cut and to curve into rugged, streamlined shapes that—even in the substratosphere—retain their original high impact strength.

Six years of use have proved PLEXIGLAS to be "Aviation's Standard Transparent Plastic."

PLEXIGLAS tail enclosure of the B-26 shows perfect streamlining. Subjected to the severest conditions, it stays crystal-clear . . . permanently.

PLEXIGLAS *is the trademark, Reg. U. S. Pat. Off., for the acrylic resin thermoplastic sheets manufactured by* ROHM & HAAS CO.

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA, PA.

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worth waiting for!

The pleasure of anticipation is not for youth alone. When one no longer looks toward the future, he is old indeed! ★ Today Culver is *all out* for production of planes for our Armies . . . but Culver is looking toward the future when we can bring you the *Victory Model Culver.* ★ It will be new in every way . . . cleaner, more airworthy, greater economy, better looking . . . the ideal plane for cross-country trips. It is, indeed, *well worth waiting for!*

UNDER CONTRACT TO THE U.S. ARMY AIR CORPS

CULVER
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LET'S GO! U.S.A. KEEP 'EM FLYING!

CULVER AIRPORT
WICHITA, KANSAS, U.S.A.

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Ideas Make Airpower

(*Continued from page 52*)

on a scientific basis. Already most of the practicable ideas have been put to work in the factory.

"Just how much saving of time and actual cash has resulted from these ideas, it is impossible to tell," says Boise. "Unless the suggestion eliminates some mechanical part or time-consuming operation on which the cost accounting department has definite figures, you can't translate the saving into tangible dollars.

"There's no guesswork, though, as to whether or not these employee ideas have been valuable. Because of them, more planes will be built faster for the same money. The value of time saving is self-evident. And since the money for war work comes from the Government, it is the nation as a whole that benefits from the suggestion system."

More important than cash awards to the suggestion winners is the fact that the man who continuously contributes to the improvement of productive efforts is credited with them and is proving himself capable of meeting management problems. Every employee has an opportunity to present his ideas to the management now, and need no longer say, "If I were running this place I'd do so-and-so." He can tell the company all about it.

The novel twist about the Boeing system is that the employee-with-an-idea remains anonymous until his suggestion has been accepted or rejected. If it's rejected he needn't be self-conscious, feeling that someone thought his idea foolish, because no one will know who submitted it anyway. On the other hand, there's no chance at all of personal prejudice or favoritism entering the picture.

The suggestion blanks are numbered and the employee simply tears off and keeps the stub which bears the same number. After that he watches for his number to appear on his shop bulletin board, listed either as a winner or as a rejection. If his suggestion has been accepted, he steps up and identifies himself.

There is no set number of acceptances per month. Each suggestion that Boise and his staff consider a possibility is submitted to the head of the department to which it applies and is judged solely upon its practicability and value. The scale of cash awards set up to launch the program was this: improvement of design or production, $15; reduction of cost, $10; improvement of manufacturing methods, $10; improvement of manufacturing equipment, $10; elimination of waste (time and material), $10; elimination of accident and fire hazards, $5. But if a particularly outstanding suggestion comes along, upon the recommendation of the industrial engineer and the approval of the management, additional compensation may be awarded.

Top prize of the first four months was awarded to B. E. Reynolds of the inspection department. Strictly secret, Reynolds' idea involves a design change on the *Flying Fortress* which will make production easier. But it's no secret that it brought him $100.

The $100 prize was quickly followed by two more "special merit" awards of less money. One went to Jack Stretch, for a new clamp designed for elevator and tab systems. Suitable for use in seven different spots, the clamp holds cables on the drums while tension is being released for adjustment. George Mathay took the other special award for his design of a new type squeeze for placing grommets, the little aluminum eyelets that are replacing the larger fasteners on much assembly work. By putting the squeeze on assembly, Mathay has increased production and reduced man-hours on the job.

Speaking of grommets, their use in aircraft production is the result of a highly successful suggestion made last year by a Boeing shop foreman named Oscar Leibst. Leibst won the Revere prize and national attention last year by devising a method of sub-assembly of circumferential and longitudinal stiffeners—the framework which makes up the fuselage of an airplane—by simplifying the construction and making use of grommets.

Among other typical award winners produced thus far by the novel program are these:

C. A. Weaver came up with an idea for improving the design of rivet hand squeezers. He suggested that the jaws be offset at a 45° angle, submitting a cardboard model with his suggestion blank. A pair of squeezers were built to specifications; they worked, and from now on others like them will help in pressing rivets in almost inaccessible places.

Another idea on rivet squeezers came from Lester L. Smith, who showed how a particular type of squeeze could be opened automatically by means of a spring, instead of by hand.

S. F. McClung simply turned over an inter-departmental mailing envelope, discovered it had two sides, and suggested both sides be lined for addressing. Sometimes, says Boise, the simplest ideas are the most practical ones.

Frank W. Hill invented a time-saving device for threading cloth washers onto bolts. Tom Lang designed and built a tool with which drilled holes can be burred both on outside and inside. Don Sadler produced a design for an automatic ejector for power brakes, to remove parts after forming.

To qualify for an award, a suggestion does not necessarily have to be useable. Raymond Clift won a prize with his jig design for properly locating the dimples that are put in ammunition box covers. Though his particular design won't be used, his suggestion pointed

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Read 'em and Weep

(for the Japs – if you can)

The Bomber That Broke the Japs' Hearts at Midway

smooth song of power
)0 horsepower engines,
'ces' newest champion
through its paces over
the hands of Uncle
MacDill field.
Martin B-26 medium
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their valiant crews did not return to their bases, but the score was 10 men and two $200,000 planes for two Jap carriers, each carrying over 1000 men in its crew and worth several million dollars. And adding to the score, the planes from the enemy carriers, which found no place to roost, went down in the Pacific.

* * *

The B-26's scored again in the battle of the Aleutians by sinking a cruiser and putting an aircraft carrier out of action.

They also struck hard at Cologne in Germany, in the Mediterranean, and in Coral sea, proving that whether the objective is an enemy base on land or a battleship at sea, the medium-size, medium range, but tremendously swift medium bomber, of which the 26 is today's shining example, can blast it at smaller loss than any other weapon.

Brig. Gen. Jimmy Doolittle has let the world know what he thought of the B-26 by using one on various military missions since he led the raid on Tokyo. That particular job was done in Consolidated B-25's which is just about as effective as its sister 26 but not quite as fast. It was General Doolittle who gave MacDill and Tampa their first glimpse of the 26 when he landed here about six weeks ago.

* * *

What makes the B-26 one of the most potent bomber-torpedo planes in the world today? Just a look at it will

MARTIN BOMBERS SINK JAP CRUISER

Direct Hit Scored On Plane Carrier In Aleutian Island Battle

United States torpedo planes sank a Japanese cruiser and scored a direct hit on an aircraft carrier of the main Japan[illegible] task force attacking the Aleutian Islands, it was flying Martin B-26's as torpedo

Allies Compare Planes:

Martin Bombers Best Against Foe

By HAROLD GUARD
United Press Staff Correspondent.

SOMEWHERE IN AUSTRALIA, Aug. 7.—Eight months of war have taught the Allies that pre-Pearl Harbor conceptions of the Japanese as poor fliers using inferior planes were wrong.

Any American pilot will tell you that the Japanese flier knows the score and that the improved Zero plane is one of the world's finest fighters.

The fact that Allied planes have proved a match for Zeroes on the 2,000-mile front north of Australia is a tribute to their pilots' flying ability.

MARTIN B-26 BEST

The American-made fighters that go against the Zeros are the Bell Airacobra and the Curtiss Kittyhawk, but it is the Martin twin-motored Marauder bomber—the B-26—that battle reports show to be the most effective.

American pilots like their own planes but they frequently express a wish that they had a little more of the Zero's all-around capabilities, especially its ability to climb fast and get on top in combat and its wide operational range.

Every pilot tried to get above his opponent in a dogfight and that's where the Japanese plane seems to have the edge. I recall an occasion in which several pilots told of surrounding a lone Zero. They figured they had it tagged. One said:

"And then what does he do? He goes straight up and leaves us

embodied in its construction. The engine is of the Pratt & Whitney type. German and American ideas are noted in the instrument panel arrangements.

Many structural features ape those of the British Hurricane and the armament is much like that of British fighters.

It was tested for years against the Chinese, for the Japanese apparently used China as a laboratory for the machines they later used against the United Nations.

FARES BETTER

A study of Army communiques shows that the Martin bomber has fared better against the Japanese than the Airacobras and the Kittyhawks. The Zero can outrace the twin-motored heavier Martin, but it can't outgun it and it cannot take the steep dives or fly at low level with the American plane.

Once the B-26 is in the air it can take care of itself, and pilots say the Japanese have a healthy respect for it. There have been instances where a B-26's cannon literally tore Zeros to pieces, and many pilots believe that the best plane to whip the Zero will be one somewhere between the B-26 and the fighters they now are [illegible] the best of both

Martin

B-26 BOMBER

Builders of Dependable Aircraft Since 1909

out to the tooling department that there was room for improvement in the system. A similar case was R. E. Ralston's proposal that press-fit bushings be used in a particular machine. His specific idea was shelved, but its result was replacement of the old-type bushings with floating ones.

Earl S. Newell designed an improved jig for construction of the *Flying Fortress's* forward entrance door. Orlando M. Nagl told how to simplify the construction of sidewall telephone boxes in the ship.

Time clocks have been made to work overtime as the result of a suggestion by Art Grauman calling for their use to stamp shop order location cards on their arrival at the shops. The time of each card's visit to each shop is stamped upon it, showing the order of its route and thus eliminating a source of some confusion in the production location system. Similarly, William Ford struck on an idea that will improve the speed and accuracy in transcribing information from requisition cards.

Boeing employees will be able to hear announcements over the public address system better as the result of Ben Bush's suggestion for the installation of filters to cut off certain frequencies.

In the way of suggestions for making the life of employees a little safer on their jobs, M. B. Barton proposed a safety railing and ladders for repair and maintenance work on the large punch presses. Gordon S. Cummings suggested placing plywood over the glass in the lower panels of tunnel exit doors, eliminating the chance of hands being thrust through the glass.

That's the way it goes—technical suggestions and simple ones. Maybe some of them seem like little things, but add a few hundred of them together and see what you get. Boeing figures it is getting a lot.

"We make it clear," says Ted Snow, industrial engineering assistant in charge of the idea collection, "that a suggestion can be a non-winner and still have a lot of merit. Hundreds of those submitted are not eligible for awards, yet they contain constructive criticism that the management is glad to get.

"For instance, there's the matter of cleaning. It's very unlikely that a suggestion on this would be a winner, because if there's a case of negligence in cleanup it's merely a matter of calling it to the attention of the department responsible. But the management is glad to hear about it."

The first requirement Boeing's industrial engineering department lays down with regard to winning suggestions is that they must be more than just good *ideas*. They must be practical, and their originators must explain *how* they are going to work. "Nobody," says Ted Snow, "is going to become a national hero these days, by suggesting that someone ought to invent a cheap, plentiful substitute for rubber. But the man who could offer a practical plan for accomplishing this goal could be our next president if he wanted."

The men behind the Boeing plan ask that suggesters send plenty of sketches with their ideas and, if necessary, a model of their design. They emphasize, too, that they don't want suggestions that an employee can put into effect himself merely by speaking to his foreman.

Without question, the suggestion system is playing a part in the success of the nation's mass production which has amazed even Americans. It has brought new, workable ideas by the thousands. More important, it has recognized the American workman as the smartest, most ingenious workman in the world. He, just as much as the man at the bomber's controls or the man behind the machine gun, is the guy who's going to win this war for America.

END

The Stratoliner

(*Continued from page 32*)

the air. TWA found that by adding only five men, making it 30, they had a sufficient ground personnel. Cost of this crew amounted to $70,398, approximately one-fifth of the purchase price, over the operating period. No. 401 was pretty well behaved and went into repair shops along the line on only a few occasions. However, she did get a careful check every 20 hours, which meant that she was rolled into the hangar 284 times in the course of her service. Some items of expense in this connection: A small matter of 1,656 sparkplugs, costing $4,388. (Remember that each full replacement calls for 112 plugs.) Five sets of replacement tires, costing about $1,000. Tires are guaranteed for 1,000 hours of flight, which means about 300 take-offs and landings. Nine major overhauls at an individual cost of about $478 per operation. Multiply by four to get the price for four motors.

An item which you'd probably overlook is the cost of cleaning and laundering sheets, pillow cases, head rests, carpets and other items, as well as their replacement due to wear and tear. Overall cost of laundry was $2,200. Life of blankets and sheets, due to the fact that TWA buys only the finest and lightest obtainable, is sometimes three or four years. So the equipment for the 16 berths didn't wear out. Head rest covers, napkins, hand towels and pillow cases, which are soiled or stained more easily (Lady, watch that lip rouge!) last only six or eight months. Carpets are removed and cleaned with each 20-hour operational check, which means that they met up with the vacuum cleaner 284 times. Replacement on all of the above amounted to $486.27.

TWA maintenance crews report that passengers are neat, clean and careful. They respect equipment. The main damage, believe it or not, is holes torn in seat covers. The cost of repair is negligible. No. 401 never went back to the factory for any kind of modernizing or repair work. The reason for this is that she stood up well. Another is that TWA's repair and maintenance facilities are so complete that it is possible to do everything but actually build the planes.

For instance, consider upholstering. Upholstery work is based on the condition of each individual seat—some seats are more popular with passengers than others and are therefore sat in more often—and the work is done at the TWA Kansas City depot. It is estimated that "401" was completely upholstered once at a cost of $8,800.

Just about all of TWA's specially qualified roster of 42 pilots flew "401." She never left her three-stop transcontinental route. She seldom changed her dress with the seasons, except that in winter she donned her special de-icing equipment, which included de-icers on wings, stabilizers, propellers, windshields, carburetors and pitot masts. In the case of the last three items, these were installed for the first time on "401" and her sister ships—necessities for high-altitude flying.

There is an adage that a good airplane is never finished, not even after it is placed in operation. There are always improvements to be made as months and years pass. And "401" was no exception. During her period of commercial operation she got the afore-mentioned gyro-stabilized compass, remote transmitting compass, celestial navigation equipment and flight analyzers. She also drew a pitot static blowdown system which allows lines connecting air speed indicators to be cleaned during flight, preventing the accumulation of moisture. Her fuel quantity measuring system was perfected. Supplementing this, fuel flow equipment was installed to permit a constant reading of the weight of fuel the engines consumed.

In the fall of 1940, our "401" received completely new and modernized carburetor and fuel systems. These systems included auxiliary fuel pumps to replace former hand operated pumps, and a dual type fuel system, separate and interchangeable for each engine. Had she continued in service, this list would have been much longer.

All in all, while her cost was only $351,990, more than $750,000 was spent in all departments to keep her operating. But she made a lot of money. She hauled a lot of passengers, mail and express. And she and her sisters opened the curtain of the future to give us a glimpse of the better things which are coming after the war is ended.

END

Organize Junior CAP

THE formation of a young people's volunteer aviation corps has been announced by the Civil Air Patrol. To be known as the Civil Air Patrol Cadets, this organization will parallel that of the senior CAP. Initial membership will equal the 60,000 enrollment of the CAP, as each CAP member is entitled to recommend one junior for membership in the Cadets.

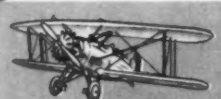
...and a HELLDIVER it is!

When, in 1928, Curtiss-Wright built the first carrier-based Navy airplane designed specifically for dive-bombing, its then sensational ability inspired the name, "Helldiver." Today's Helldiver, the new SB2C-1, more than ever justifies its name—for its flashing speed and the greater destructive power of its heavier bomb load and deadlier armament have won the rating of "world's best" in the judgment of impartial authorities.

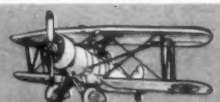
SECOND PRINTING: Send 10¢ for your copy of this fascinating 96-page history of aviation by Assen Jordanoff, author of "Your Wings", with illustrations of current fighting types. Airplane Division, Curtiss-Wright Corp., Buffalo, N. Y.

CURTISS-WRIGHT
Corporation
AIRPLANE DIVISION

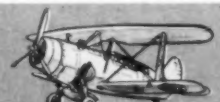
FIRST
Since the Birth of Aviation



1928 • First United States Navy Airplane built specifically for dive bombing tactics and carrier operation. Two fixed guns in upper panel and a rear swiveling gun completed the armament.



1933 • Further streamlined, using a twin-row radial engine for higher performance, the now famous Curtiss Helldiver was in use by both the United States Navy and Marines.



1937 • Many squadrons of these high performance SBC-3 dive bombers with heavy defensive armament and completely retractable landing gear saw service in the United States Fleet.

1939 • The SBC-4 powered with a Wright Cyclone, superseded the earlier type and excelled in performance. Planes of this model were still being delivered to the Navy in 1940.

Awarding Wings to Army Air Cadets

YOUR SON MAY BE our Boss

Somewhere high above a frenzied field of battle is the rhythmic roar of open throttles—the muffled sound of guns and cannon. Like miniature models, in a distant sky, a squadron of Army P-39 Airacobra pursuits piloted by American Youth battles it out against the enemy.

These are the battles for which we build. Battles that are our inspiration to make every Airacobra we build one of the world's most deadly single-engine fighters. We keenly feel the responsibility that rests upon us.

The success of our Army Air Force Pilots and every man in our fighting services depends upon mastery of the air. We at Bell Aircraft are serving these men with every ounce of ingenuity and skill at our command. They are entitled to our greatest efforts. *They* are the men for whom we work.

Among the millions of boys now serving in the fighting forces of our country you may have a son. It is our duty to serve and protect him. We are doing it by providing the mightiest weapon we know how to build. We are proud to have him as our boss. And we shall be proud to keep him as our boss. For tomorrow, when victory is won these men and boys now in service will return to their places in industry and commerce. We look forward to serving them with the planes of peace in a new world of advanced aviation. © Bell Aircraft Corporation, Buffalo, New York.

Airacobras for victory—

FUTURE PLANES FOR PEACE

BELL *Aircraft*

PACEMAKER OF AVIATION PROGRESS

The Night Bomber vs. Antiaircraft

(*Continued from page 49*)

time, no single predicted shell can hit it, except by mistake. Third, an aircraft caught in searchlights and visible to the ground is in the same position as one flying by day, and therefore has a shorter safety factor, in terms of straight and level flying, than one not illuminated. Fourth, to all intents and purposes accuracy of gunfire does not decrease with height, but at altitude evasive action has considerably more effect, and the loss of altitude brings an aircraft within lethal range of light as well as heavy caliber guns. Consequently, immunity increases with height to a certain extent, particularly in the matter of illumination by searchlights. These four components are elementary, but out of them develop the whole story and complications of tactical evasion against antiaircraft.

Let me explain by dealing with the subject chronologically. There are in essence two types of guns: heavy and light. The heavy gun fires a shell which explodes at a predetermined height irrespective of making actual contact. Its lethal range varies according to the caliber of the shell, but in any case it is comparatively small. The light guns are either machine guns or cannon. They both work on the principle of a hose pipe in that they are highly maneuverable and fire a continuous stream. Machine guns eject a solid bullet with a rate of fire of anything up to 1,400 rounds per minute, but with a very limited range. Cannons fire a shell which explodes on impact and failing that explodes at the limit of its travel. Their range may be anything up to 12,000 feet, their rate of fire in the region of 500 rounds per minute, and their lethal range, other than by direct hit, nil. Apart from a few fancy gadgets, these are the only two types of weapons available to the ground defense forces. The rest—the predictors and the searchlights—are merely instruments to help the gunners.

In the early stages of the aerial war, the ascendency of bombers over ground defense was very marked. Against ordinary evasive action—alteration of course by 10° on alternate sides of the required track—neither guns nor searchlights were very effective. Furthermore, guns were found only over strategic towns and targets. In this phase the percentage of damage to the targets per aircraft despatched was very high. On targets other than the Ruhr and the coastal ports the average bombing height was low enough to enable crews to see the ground even on a dark night, and over the Ruhr itself no one flew higher than 7,000 or 8,000 feet. This phase, from May, 1940, to the middle of September, was the heyday of night bombers. It was a phase in which ordinary evasive tactics were sufficient to defeat the guns, and in which crews could with impunity fly low enough to identify and hit a small target. Nonetheless, out of this phase emerged one fact of outstanding importance, a fact which was to alter the whole course of night warfare. The sole job of a bomber is to get from base to target, to hit the target and then to reach its base again safely. Consequently any action of the ground defense organization which directly causes the bomber not to hit its target—even though the bomber is not shot down—means that the organization has achieved its object. That was the crux of the issue and the Germans wasted little time

in realizing it. Navigation by night is a difficult matter, in that only under very exceptional circumstances is it possible to rely on assistance from a visual pinpoint. In brief and untechnical terms, an aircraft beyond visual range of the salient features of the ground can reach a selected destination only by maintaining a wholly accurate course, air speed and height, and by an exact knowledge of the wind velocities. Any deviation therefore from level flight decreases the chances of reaching the selected destination. In the first phase of operations such deviations from course as were made due to evasive tactics were of no serious consequence, but for the sole reason that normally aircraft were able to retain visual contact with the ground.

After September, 1940, the Germans reduced the ascendancy of night bombers over their defenses. In the first place they had begun to drive us up to a height at which visual pinpointing of anything else than water was very difficult, except of course under conditions of moonlight. The direct result of this was that an aircraft taking evasive action was materially decreasing its chances of finding the target. In the second place the Germans set about minimizing the effect of Rule No. 2. (If an aircraft does not fly straight and level for more than the time interval between the initial sighting by the ground defenses and the bursting of the shell, no single predicted shell can score a direct hit, except by mistake.) There were many ways of doing this. They added greatly to the number of their guns, so that the sum of the errors in compution and in the flight of shell helped to compensate for the aircraft's evasive action. They increased the power and distribution of searchlights in order to enable the gunners more frequently to fire over open sights and thereby cut down the time lag between sighting and the shell burst. Furthermore, they began to resort to cunning. The defenses would remain quiet, although there were aircraft overhead, so as to let the pilot think he was perfectly safe. This meant that if he were not already taking evasive action he had only the time between the firing of the gun and the bursting of the shell in which to evade—and then only if he happened to see the gunflash on the ground.

Over Cologne one night towards the end of 1940, there had been accurate and intense gunfire for some 20 minutes and then suddenly, as if by magic, everything closed down. Not a sound or a flash or a searchlight anywhere. It was the most eerie sensation I have ever felt. We knew it was not just that they were tired of firing, so we continued weaving. For 10 minutes it lasted, all the way to Cologne itself, and knowing that there was a trap of some sort in the offing we began honestly to wish that the guns would open up and let us know the worst. Unfortunately when the time came we never noticed the flashes on ground. The first shell blew the front Perspex [similar to Plexiglas.—Ed.] in, the second was virtually a direct hit in the fuselage.

Our own evasive action tactics had not been violent enough, and the German tactics were good. In addition to this and other methods, their most notable achievement was the adoption of what can most easily be described as the box barrage. Instead of individual batteries firing on their own individual predictions an imaginary cube was predicted in the sky with the aircraft as near as possible in the center. At a given zero hour every available gun filled this cube with shells without bothering about further predictions.

It will readily be grasped that quite obviously ordinary evasive action, however violent it might be, was useless against this form of attack, because the guns were concerned with lethalizing the

FLEETWINGS

Builds the parts for America's Air-mada

IN a hundred plants scattered over the country, America assembles the air-mada to master the air over every fighting front.

But before the planes (and Victory) must come the parts—wings, fins, tail surfaces, ailerons, stabilizers, fuselage sections, and more.

Fleetwings is building these parts . . . by the hundreds, by the thousands. And Fleetwings is building them faster than they have ever been built before.

To do this, Fleetwings pioneered with new metals, new techniques, new processes. Old methods of fabrication were streamlined, new methods invented.

Although our present production is all for Victory, we haven't forgotten the future. Plans for that future are on Fleetwings drawing boards *now*. With Victory they will be revealed and the pioneering of Fleetwings engineers will add still greater chapters to America's air history.

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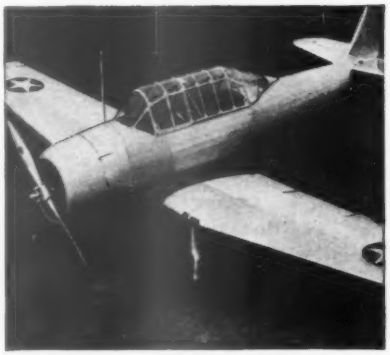
FLEETWINGS

pioneers with parts and hydraulic equipment



The BT-12, all-welded basic trainer built for the U. S. Army Air Forces.

TO "KEEP 'EM FLYING"—In addition to building myriad aircraft parts for other manufacturers, Fleetwings also builds *complete* planes. The Fleetwings-designed-and-built BT-12 has more than proved the mettle of stainless steel for military aircraft. (Incidentally, the BT-12 is the *first* all-welded military plane constructed principally of stainless steel.)

LEAVE IT TO FLEETWINGS—to give a new "twist" to the nation's scrap-saving program. In the Fleetwings plants, there's an active campaign *to keep scrap from becoming scrap!* Vital plane hardware—nuts, bolts, rivets, clecos, and washers—is being conserved through a company-wide program which stresses that "every rivet is a bullet" and that plane hardware should be treated as though it were rationed ammunition—and not to be left where dropped.

OVER 1100 HOURS—were saved on a recent job at Fleetwings through the use of a new and simplified Template Reproduction Process. Another example of how Fleetwings is speeding plane and plane parts production.

ANOTHER FLEETWINGS ADVANCE—is the use of isometric, three-dimensional graphic illustrations along assembly lines to speed and facilitate production of airplane surfaces. These graphic illustrations, made in our Tool Design Department, show the exact position and procedure for every nut, bolt, rivet, washer, etc. and greatly simplify assembly work for men with little or no training in the reading of blueprints.

"KEEP 'EM FLYING!"

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cube, and the longer the aircraft stayed inside it the greater were its chances of being shot down. There was one remedy only: to get away from that area of the sky as quickly as was physically possible and to start all over again. Or, alternatively, to continue on a straight and level course and hope for the best.

Even in the heaviest gun concentration, with everything in their favor, the defenses can never guarantee a direct hit. On this point another night about the same time is an interesting example. A small force was sent out to attack a place in the heart of the Ruhr. There was a half moon, and from 7,000 feet the ground stood out comparatively clear. One of the attacking *Whitleys* set course for the middle of open country 30 miles south of the target which without guns or searchlights was easy to find. Having identified his position, the captain flew off north on a dead straight and level course. There was not a sound from the defenses. He came on up the railway and on E.T.A. (estimated time of arrival) found himself slap over the target. To make doubly sure he circled once, confirmed that it was the right factory and set course back down the railway to give himself a long enough bombing run. Still not a sound from the defenses. After three or four minutes flying he turned abruptly round through 180°, throttled back and headed straight for the target. It might have been a walk-over, but when at 3,000 feet the guns opened up, the first salvo threw the *Whitley* almost onto its back. Simultaneously with the guns the searchlights caught him, and every available cannon—of which there were a great number—was brought into action. The duel lasted in all 40 minutes, during which time the pilot tried every conceivable maneuver without once throwing off the searchlights. He made three separate bombing runs, but owing to the dazzle never found the target. It was bad tactics: the guns could only have been silent for one reason, that they wanted to catch him redhanded. Perhaps he knew what was likely to happen, but gambled on finishing his bombing before the guns opened up. In view of what was at stake it was probably a justifiable gamble, but it did not come off. Curiously enough, however, the Germans cut their own throats because they failed to bring the *Whitley* down and all the other aircraft bombed in perfect immunity.

Since those days of winter, 1940, the German antiaircraft defenses have not changed, except merely that they have intensified. There are more numerous and more powerful guns, more numerous and more powerful searchlights. The men behind them, too, are more skilled, by virtue of their long experience. But the problem is still the same as it ever was. To avoid being shot down is not enough. You must avoid being shot down in such a manner as not to prejudice your chances of finding your target. To do this you must know the approximate situation of defended areas and as soon as the guns open up, be able to tell what methods of prediction and what type of barrage they are using. If the shell bursts are close and there are relatively few guns, you carry out normal evasive action to prevent a direct hit—other, of course, than from a shell that does not burst where it ought to, which you cannot deal with. If there are many guns and the bursts are forming a box round you, you move out of the box as quickly as you know how. If the shells are forming a general barrage not predicted against you as an individual, you do not take any evasive action at all, because you may just as easily fly into a shell as fly away from it. Finally, you avoid being caught by searchlights if you possibly can because in the first place you cannot see the ground at all, and secondly it is easier for the guns and very much easier for night fighters.

Provided you know the rules and you appreciate the limitations of antiaircraft defenses, there is no need ever to be shot down, except by being unlucky. Unfortunately that "except" is a very potent factor. There is not such a thing as a perfect shell or a perfect predictor or a perfect gunner, and the shell may not burst where it should. A pilot may take the most violent evasive action in the right direction and at the right time—and as a consequence may fly into a shell that should not be there at all. It is even possible for a shell to burst 10,000 feet lower than the height on its fuse setting; nobody can reckon with that when flying through an indiscriminate barrage. There is only one answer. You are either hit or you are not. There is no tactical evasion that you can possibly take.

There is another factor still. When shells are bursting in the sky, the air is filled with flying fragments. Even though it is not within range, it all has to come down. You only have to fly a vulnerable part of the airplane into one small piece and you lose an engine, perhaps the whole airplane itself.

Napoleon never promoted a general unless he was by nature lucky. The same maxim for success holds good now. The ace bomber pilot can beat the guns every time, but only up to the point where predicted accuracy gives way to luck pure and simple. Beyond that, his career rests with God.

END

Goggles Conquer Sun

NEW types of flying goggles, one of which permits observers to look directly at a blinding sun and spot dive bombers, have been designed by the American Optical Company at the request of the Army and Navy.

I. Ae. S. Meeting

THE 11th annual meeting of the Institute of the Aeronautical Sciences will be held during the last week in January, 1943. To enable members to attend meetings with the least loss of time, technical sessions will be held simultaneously in Los Angeles, Detroit and New York. Papers will be presented by proxy at meetings at which the author cannot be present.

A "Helldiver" Screams Down on the Target!

ITS WRIGHT CYCLONE ENGINE POWERED BY

SHELL

TAKE-OFF, power dive, pull-out . . . the throttle response of this deadly dive bomber must be instant . . . sure. For on its performance hang the lives of the crew.

That's why in this new Curtiss "Helldiver" (SB2C-1) with its Wright Cyclone engine, and in many of its other ships, Curtiss-Wright uses Shell Aviation Fuels. You'll find this same preference from coast to coast among many plane and engine manufacturers, aviation training schools, transport lines and airports . . . not alone for Shell Aviation Fuels but for AeroShell Oils as well.

Airport operators all over the country have found this fast growing line of Shell Products profitable to handle.

Model of the new Curtiss "Helldiver" (SB2C-1) Dive Bomber shown, courtesy of the Curtiss-Wright Corp., New York, N. Y.

SHELL

AVIATION FUELS · AEROSHELL OILS

The Ladies Join the Air Forces

(*Continued from page 67*)

The announcement made September 10 by Secretary of War Henry L. Stimson of the formation of an experimental unit of women pilots was the realization of an idea that would not down. More than a decade ago there was a Women's Air Reserve, organized with the aim of becoming an Air Corps auxiliary in an emergency. About the same time there was a Betsy Ross Corps. When war came, women flyers—more than 2,000 of them—found some outlet for their enthusiasm in the Civil Air Patrol, but they were not satisfied.

Some hopeful progress was made last year when Miss Cochran made a survey of the possibilities of making use of air-women. But the exclamation credited to the high-ranking officer reflected official sentiment at a time when the Air Forces were in the primary throes of the vast expansion for the conflict then clearly foreshadowed. Miss Cochran, disappointed at home, turned to another job, that of recruiting capable American women flyers for service with the British Air Transport Auxiliary.

In March of this year, with greater official encouragement, Mrs. Love quietly began laying the groundwork for the WAFS by beginning a study of ferrying military aircraft, within the operations section of the former Ferrying Command. Her husband, Lieut. Col. Robert M. Love, is deputy chief of staff of the succeeding Air Transport Command. Arrangements had been worked out in detail when Secretary Stimson came out with his announcement.

Immediate aims and plans were well publicized at the time, but will bear recapitulation by Mrs. Love herself.

"The squadron was formed to release men for more difficult flying jobs," she explained. "At the present time, many skilled men are being used to ferry the light types of planes. With women handling these types, the men can be used to ferry more complicated aircraft to various points in this country and to war combat zones."

By light types, Mrs. Love explained she meant PT-19 primary trainers and L-4B liaison craft which will be flown at the outset. But for the future, the Army is placing no arbitrary limits on the kind of planes the women may be permitted to ferry. Said Maj. Gen. Harold L. George, supervisor of the women pilots as chief of the Air Transport Command: "If they show they can fly four-engined bombers safely after proper periods of training and preliminary work, I see no reason right now why they may not get the chance."

The airwomen were disappointed in one respect. They are to be civilian employees of the transport command, and hired on three-month contracts. Men civilian pilots of the ferrying division of the ATC likewise are civilians, but only at the outset, as after 90 days those with proper qualifications are commissioned. There is a hopeful precedent there.

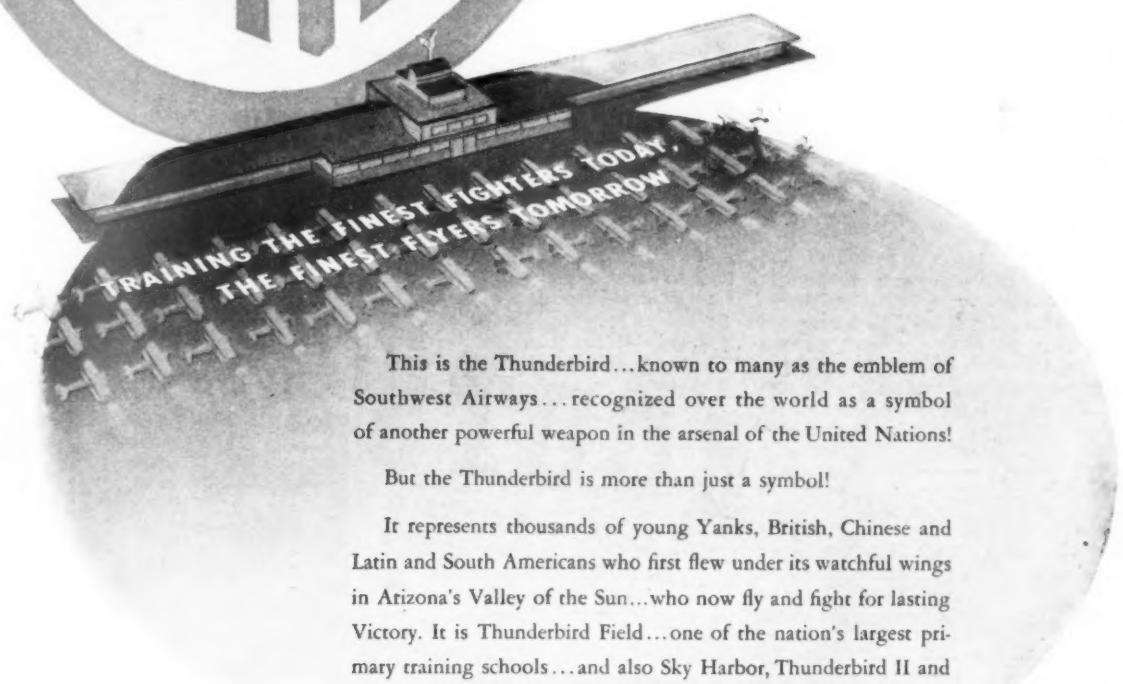
Certainly no suspicion can be felt that the first WAFS were attracted by the idea of making a fortune. Their pay was set at $250 a month, under $60 a week, which is less than that of countless numbers of semi-skilled workmen in these wartime boom days. A number already were flight instructors at better pay than offered by the Army. When on ferrying trips they are granted the conventional $6 a day for expenses.

The Army base "somewhere in the East" where the first group of recruits underwent tests and started a four-week indoctrination course of instruction was designated headquarters of the WAFS and there the pioneers were assigned quarters like those of bachelor Army officers. After completion of their initial schooling, Mrs. Love predicted they will spend only about 10 per cent of their time there. When they are on ferrying trips they live in hotels.

For the schooling period, the WAFS were given regular Government-issue flying suits, but could look forward to donning natty gray-green uniforms when they actually started operations, with skirts and optional slim-hipped slacks. Incidentally they were required to pay for the uniforms themselves. The outfit includes short jackets, with detached belts trimmed with brass buttons. The command insignia, a modernistic design of an airplane flying across the top of the world, is worn along with the wings of the civilian pilot over the left breast pocket.

(*Continued on page 96*)

THUNDERBIRD FIELD



This is the Thunderbird...known to many as the emblem of Southwest Airways... recognized over the world as a symbol of another powerful weapon in the arsenal of the United Nations!

But the Thunderbird is more than just a symbol!

It represents thousands of young Yanks, British, Chinese and Latin and South Americans who first flew under its watchful wings in Arizona's Valley of the Sun...who now fly and fight for lasting Victory. It is Thunderbird Field...one of the nation's largest primary training schools...and also Sky Harbor, Thunderbird II and Falcon fields. And it is the Southwest Airways employees who night and day "keep 'em flying"...who never forget their pledge—*the finest fighters today, the finest flyers tomorrow!*

SOUTHWEST AIRWAYS

THUNDERBIRD FIELD • FALCON FIELD • SKY HARBOR • THUNDERBIRD II

Phoenix, Arizona

CONTRACTORS TO THE UNITED STATES GOVERNMENT • UNITED STATES ARMY • UNITED KINGDOM GOVERNMENT

Service in Action

Over the far Pacific, through the icy blasts of Alaska, and above the Sahara sands—on a score of widely separated fronts, American planes, fabricated with Boots Self-Locking Nuts, are meeting the severest test of all—war.

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③ *North American B-25*
④ *Curtiss Commando, C-46*
⑤ *Consolidated Liberator B-24E*
⑥ *Curtiss P-40*
⑦ *Curtiss Dive Bomber SB2C-1*
⑧ *Edo Floats*
⑨ *Plywood Planes*
⑩ *Brewster Buccaneer*

A few of the planes fabricated with Boots Self-Locking Nuts

Boots Self-Locking Nuts For Application In All Industries

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General Offices: New Canaan, Connecticut

HOW IT WORKS

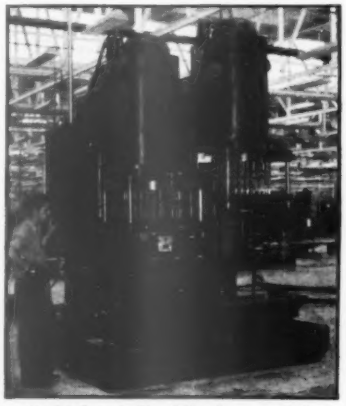
The Boots Self-Locking Nut is one-piece, all-metal—withstands severest vibration. The top (locking) section is displaced in a downward direction so that its locking threads are out of lead with the load carrying threads of the lower section.

Upon the insertion of a bolt, the top section of the nut is extended to engage with the threads of the bolt. A constant force is thus established which locks the nut firmly into position without damaging bolt or nut. Axia thread play is eliminated.

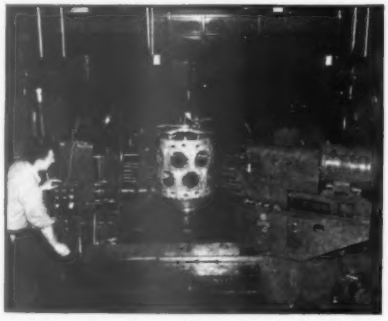
Industrial Aviation SECTION

SPEEDING ENGINE PRODUCTION

by WILLIAM HENRY PANKE
Assistant General Superintendent, Wright Aeronautical Corp.



Multiple-spindle drill plays a vital part by drilling 38 holes at a time.



Fully automatic machine reams and taps 280 holes, replacing 19 other machines.

Conveyor lines speed up production of cylinder assemblies at one of the Wright Aeronautical plants, saving many hours previously lost through manual handling.

THE amazing advances in aircraft engine production made during recent months are attributable mainly to the development and adoption of high-speed automatic machine tools. The advantage of this type of equipment is two-fold: not only will a single machine take the place of several of the old-style standard machines, but to such an extent has the essential skill been incorporated into the automatic mechanism that an unskilled, or at best a semi-skilled operator, can produce an unlimited quantity of exactly similar parts while holding the manufacturing tolerances to within a few ten-thousandths of an inch.

Typical of this procedure is a machine which reams, countersinks and taps 280 holes in the crankcase of a Wright *Cyclone* aircraft engine. An electric hoist loads the part on to the machine where the operator locks it into place with a special clamp so designed that while sufficient pressure can be applied to hold the part there is no possibility of damaging it by excess pressure. Pressing an electric switch sets the machine in motion, and all operations thereafter are entirely automatic until half of the holes have been machined, when the machine stops. The part is then inverted and the operations repeated for the remaining half of the holes. To handle this job by conventional methods would require the use of no less than 19 standard machine tools under the care of skilled machinists.

Countless man-hours formerly consumed in trucking parts from machine to machine are now turned to productive use by the use of a complete conveyor system. Cylinder assemblies are carried along a row of grinders for the final grinding operation on the cylinder bore. Hooks engaging in the rocker boxes and in one of the holes in the cylinder flange assure complete safety from injury during the long journey through the department.

Designed specially for the purpose, a special multiple spindle drill drills 38 holes of three different sizes in the flange and center hub of a *Cyclone* nose section. In order to meet Wright's standards of precision these same holes must then be reamed to size. This is performed on the same machine by engaging a special traverse mechanism which causes the work table carrying the part to travel into position under the second drill head at the right-hand side of the machine. This machine tool is in effect two separate, multi-spindle drills combined into a single unit to eliminate the necessity of transferring the parts by hand from one machine to another.

While equipment of this type has played the major part in speeding up the tempo of production, smaller items have by no means been neglected. As the result of exhaustive tests made over almost a year, and involving the machining of thousands of parts, Wright Aeronautical has recently announced a new method of sharpening lathe tools. In place of permitting the operators to regrind their tools by hand, Wright now precision grinds these and finishes them to about three micro-inches surface finish. This has resulted in increasing the tool life by as much as 1,000 per cent and has effected substantial economies in vital tool steels as well as saving many machine hours formerly lost while the tools were being hand ground.

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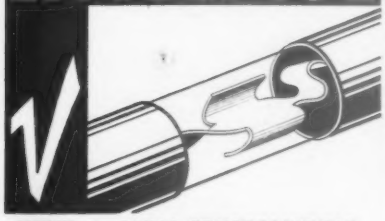

5 AG. Littelfuse Aircraft Anti-Vibration type

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PLANE PRODUCERS UNITE

G. W. Vaughan, leader of movement to organize East Coast Council, signs incorporation papers.*

THE aircraft manufacturers of the east have pledged their wholehearted co-operation toward achieving world-wide American air supremacy by agreeing to immediately pool their combined resources of engineering, research, manufacturing techniques, facilities, materials and personnel in an all-out endeavor to attain maximum output of planes as speedily as possible.

To this end they have formed a non-profit corporation known as the Aircraft War Production Council, East Coast, Inc., which will serve as a clearing house for co-ordinating the efforts of member companies. Information and technical data develped by the Council will be made available to all airframe manufacturers engaged in war production.

The manufacturers who organized the Council operate factories throughout the area of the Mississippi River, and are major producers of bombers, fighters, dive-bombers, troop transports, flying boats and other aircraft types. They are: The Aviation Corporation, Bell Aircraft Corporation, Brewster Aeronautical Corporation, Curtiss-Wright Corporation, Eastern Aircraft Division of General Motors Corporation, Fairchild Airplane & Engine Corporation, Glenn L. Martin Company and Republic Aviation Corporation. All retain their individual identity in the Council.

G. W. Vaughan, president of Curtiss-Wright Corporation and leader of the movement to organize the Council, was elected as its first president; Glenn L. Martin, president of the Glenn L. Martin Company, was named first vice-president; and J. M. Scanlan, assistant secretary of Curtiss-Wright Corporation, was made secretary and treasurer. Temporary headquarters have been set up at 30 Rockefeller Plaza, New York City.

It was emphasized by Mr. Vaughan that information and technical data developed by the Council will be available to all airframe manufacturers engaged in war production; and that the group will cooperate closely with the Aircraft War Production Council of the west coast, the Automotive Council for War Production and the various Government and industrial agencies. It is hoped that aircraft accessory manufacturers who are prime contractors will later be included in the Council.

The Board of Directors of the new Council, comprising the heads of the participating companies, includes Victor Emanuel, president, The Aviation Corporation; L. D. Bell, president, Bell Aircraft Corporation; C. A. Van Dusen, president, Brewster Aeronautical Corporation; G. W. Vaughan, president, Curtiss-Wright Corporation; L. C. Goad, General manager, Eastern Aircraft Division of General Motors Corporation; J. Carlton Ward, Jr., president, Fairchild Airplane & Engine Corporation; Glenn L. Martin, president, the Glenn L. Martin Company; and Ralph S. Damon, president, Republic Aviation Corporation.

The Council will change its officers every three months, the first vice-president automatically succeeding to the office of president. Meetings will be held monthly in the various plants of member companies on a rotating schedule.

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* Seated, left to right: Glenn L. Martin, president of Glenn L. Martin Company; Mr. Vaughan; Victor Emanuel, president of The Aviation Corporation. Standing, left to right: O. L. Woodson, vice president of Bell Aircraft Corporation; R. S. Damon, president of Republic Aviation Corporation; J. Carleton Ward, Jr., president of the Fairchild Airplane and Engine Corporation; L. C. Goad, general manager of the eastern aircraft division, General Motors Corporation; and George Chapline, vice president of Brewster Aeronautical Corporation.

New South Bend TOOLROOM Precision Lathe

Telescopic Taper Attachment turns and bores tapers up to 3½ inches per foot smoothly, easily and accurately. Telescopic feature eliminates necessity of disconnecting cross feed screw when taper attachment is in use.

THE NEW South Bend Toolroom Precision Lathe has been designed and built for efficient service in the modern toolroom. Standard equipment includes draw-in collet chuck attachment, micrometer carriage stop, thread dial, chip pan, collet rack, and telescopic taper attachment.

Spindle speeds range from 21 to 725 R.P.M. Quick change gear box makes all threads and feeds instantly available. Large diameter handwheels, clear-cut easy reading graduations, and conveniently arranged controls reduce operator fatigue, and assure maximum production.

Smooth, vibration-free operation at high speed is assured by the direct belt drive to the spindle. A wrenchless bull gear lock permits engaging the back gears quickly when slow speeds are required for machining large diameters.

"HOW TO RUN A LATHE"

A practical reference book for machinists, apprentices and shop students. Contains complete information on the operation and care of a metal working lathe, grinding cutter bits, turning, boring, drilling, etc. Over 1,700,000 copies published. 128 pages, 5⅛″ x 8″, 360 illustrations. Sent postpaid for 25c.

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IDEAS WIN CASH

H. O. Sawyer shows one of his many prize-winning, time-saving ideas.

ONE of the first aircraft companies to organize an employee suggestion system, Consolidated Aircraft Corporation began making awards for suggestions in 1937. Beginning in January, 1942, the system was revamped and employee participation rose tremendously. So much so, in fact, that in May a permanent staff had to be assigned to investigate and make recommendations on all suggestions.

Between January 1 and August 1, a total of 4,067 suggestions were turned in by employees. Those put into practice have saved 399,070 man-hours—enough to build approximately 10 extra B-24 *Liberators* or flying boats. Of the total suggestions, 358 brought their owners cash awards, 1,380 honorable mention, 2,005 are still (at this writing) being considered and only 324 were rejected.

Cash awards during the January 1-August 1 period totalled $6,732.50, an average of approximately $19 per individual. Highest individual cash award was $450. Estimated net annual saving to the company amounted to $305,327.

No limit is placed on the cash amount of awards for individual suggestions. All awards are made on the basis of the estimated annual net saving resulting from the use of a suggestion after cost of installation is determined. Also taken into consideration is the completeness, ingenuity, originality and effort expended on the suggestion by the one submitting it.

All Consolidated employees, with the exception of supervisory personnel and technical personnel in engineering, tool design, production and similar departments, are eligible to submit suggestions under the plan. Technical personnel may submit suggestions not concerned with their specific duties and supervisory personnel are encouraged to turn in cost improvement proposals for which they receive no cash awards but are credited on the promotion records.

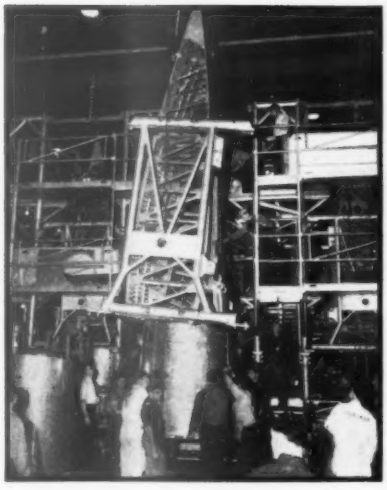
Printed forms are placed in 38 suggestion boxes located at convenient points throughout the plants. Employees put down their ideas on these forms and drop them in the boxes, from which they are collected every other day.

The spirit of employee co-operation is typified by H. O. Sawyer, leadman. Sawyer has had 11 suggestions approved since June 1, six of them in a single week. He has received a total of $383 in cash and war bonds, and still has five suggestions under investigation.

He redesigned a part; suggested a new job design; figured out a way of transferring a job formerly done by hand to machine operation, designing a new tool for the purpose; made a valve testing improvement, and designed a special dural assembly fixture. These suggestions alone resulted in an estimated annual net saving of 11,111 man-hours.

END

SKY SCRAPER JIG



Huge jig conserves Boeing floor space.

IN order to conserve valuable floor space, Boeing Aircraft Company designed wing jigs in which the structures are built perpendicular to the floor. The wing of a Boeing *Flying Fortress* being removed from the jig (above) is one of several built in the three-story jigs.

One battery of such jigs, and Boeing uses several, occupies the floor space of two wings. The new style jig, introduced by Boeing, has resulted in obtaining five times the production out of the floor area.

FLUTTER TESTER

McDONNELL AIRCRAFT CORPORATION has announced completion of vibration experiments which may help solve one of aviation's greatest problems—disintegrative flutter at high speeds. This destructive phenomenon which appears without warning and assumes disastrous proportions in a matter of seconds, is believed to be the cause of many unexplained crashes of high speed aircraft. While its presence has long been known and recognized very little detailed information on it was available.

McDonnell has engaged in a series of exhaustive tests. Using a technique new to aviation, the motion of an airplane wing during flutter was analyzed under controlled conditions simulating dynamic flight with varying weight distributions and speed factors, and results were accurately measured, recorded and photographed simultaneously.

As a result of this new technique it now is possible to see, record and measure the flutter of wings and other airplane surfaces, simulating almost any conceivable condition which might be encountered in actual flight. Thus, the flutter characteristics of newly designed aircraft may be analyzed and more accurately predicted prior to actual construction, thereby eliminating much costly full scale experimentation and delay.

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(*Continued from page 88*)

The Army made sure from the start that the WAFS should not become a refuge for dilettantes. The qualifications were made strict and Mrs. Love served notice there would be no waivers of any failure to measure up. The minimum requirements were thus set by the Air Transport Command:

Age, 21 to 35 inclusive; high school education; commercial license with 200 h.p. rating; not less than 500 hours logged and certified flying time, of which 50 must have been within the last 12 months; American citizenship; and cross-country flying experience.

Those meeting these requirements were advised to write or wire the director of women pilots, second ferrying group, ferrying division, Air Transport Command, War Department, Washington, D. C., for application blanks. After filing the application, the prospective WAFS recruit was instructed to advise what day she proposed to report at the air base—and incidentally she must pay her own expenses there. A certain day is assigned her for an interview and flight check, and when she arrives her credentials are looked over and she is given a regular Army flight check by an Army pilot.

That check of flying technique in general, including take-offs, landings, stalls, spins and chandelles, is the same as given to men ferry pilots. Once past this, the applicant appears before a board of three officers who review the record of her credentials and her flight check. That is the final stage before she is signed up.

Mrs. Love stressed that the WAFS were a group of actual flying pilots, and that there would be no ground personnel except for some top administrative officials.

The four-week schooling given the initial group enrolled was to acquaint the flyers with the Army's way of doing things. Most of these women had flown only in civilian planes, and there are many techniques used by the Army, on the ground and in the air, which are entirely different from any they had been used to. There are Army forms which must be made out in connection with the ferrying and delivery of planes, and much of the classroom work, which was limited to the mornings, was devoted to the study of these forms, along with military law, navigation and meteorology. Flying was provided for in the afternoon.

Mrs. Love voiced confidence when the WAFS came into being that there would be little difficulty in filling the initial quota of 50, but she had a limited number from which to draw. In the entire United States there are only approximately 250 women holding commercial licenses, and of these not more than 100 had had more than 500 hours at the controls. A score or more top notch American girl flyers went to England last spring and summer to work for the Royal Air Force.

It is at this point that Miss Cochran comes into the picture. A few days after the formal launching of the WAFS, her appointment as director of flying training within the Army Air Forces was announced by Lieut. Gen. Henry H. Arnold, chief of the AAF. She was directed to "create a pool of trained women pilots from which will be drawn, as needed, personnel for noncombat flying purposes, to release as many men pilots as possible for combat and other important duties." Under Miss Cochran, the War Department said, women will be trained in cross-country flying, using all navigational aids, to qualify as operating personnel for Mrs. Love's and such other units as may require their skills. Details were left for her to work out in cooperation with Army officials. She was quoted as saying the initial goal was many hundreds of trained women pilots, with the emphasis at the outset on those with 200 hours or more experience.

England's wartime record was held up as an example by Miss Cochran. The American women pilots sent there to fly were put to work with a minimum of delay, on the "hottest" military equipment, she said, reporting that "one has ferried more than 50 *Hurricanes* and *Spitfires* during the last month."

As might be expected of a new outfit whose creation represented something of a military revolution, the WAFS got off to a cautious start. The first small group of nine reported on September 21 at the base. Many otherwise qualified pilots had to await adjustment with present jobs and rearrange home and community responsibilities. A number of the first group were married. The instruction job fell to Lieut. R. H. Jordan of the ATC ferrying division, while Col. Robert H. Baker commands the air base.

First appointments by order of their acceptance included Mrs. Love, Mrs. Gillies; Cornelia Fort, Nashville, Tenn.; Aline Rhonie, New York City; Helen Mary Clark, Englewood, N. J.; Catherine Slocum, Bryn Mawr, Pa.; Adela Scharr, St. Louis; Esther Nelson, Ontario, Calif.; Teresa James, Wilkinsburg, Pa.; Alma Heflin McCormick, Philadelphia; and Barbara Poole, Detroit.

This first group had more than an average share of charm and glamor as well as aviation experience. To convey the idea, Mrs. Love, in addition to being decidedly personable, is a former student of Vassar. Miss Cochran is the wife of millionaire Floyd Odlum. Mrs. Gillies is the wife of B. Allison Gillies, vice-president of the Grumman Aircraft Engineering Corporation. Cornelia Fort is just 23, a graduate of Sarah Lawrence College and a member of the Junior League in her home town, Nashville. She was teaching flying at Honolulu when the Japs descended on Pearl Harbor. Mrs. Slocum is the wife of Richard W. Slocum, general manager of the Philadelphia Evening Bulletin. Miss Rhonie was accepted by the British as a ferry pilot but decided instead to wait for the WAFS to take form. She did evacuation work in 1939, for the British Women's Volunteer Service and served in France with the women's Red Cross ambulance corps. An artist of note, she did the murals at Roosevelt Field, New York.

Few women could approach the technical qualifications of Mrs. Love and Miss Cochran for their key tasks. The former learned to fly when she was 16, at Houghton, Mich., and was an active air enthusiast at Milton Academy and at Vassar. In 1935, she was engaged by the Bureau of Air Commerce as one of a group of flyers to air mark all the principal cities, and subsequently tested and demonstrated safety planes, while contributing to the development of the tricycle landing gear, now on most medium and heavy bombers. As an employee of an aircraft sales and charter agency at Boston she delivered new planes to purchasers in the New England states. A veteran of many air shows and races, she placed in the 1937 Amelia Earhart women's open at the National Air Races.

For color as well as aviation experience, Miss Cochran occupies a unique niche. A dozen years ago she was working in a department store and only dreaming of aviation as a career. A concentrated course of instruction at Roosevelt Field won for her a pilot's license in three weeks and launched her career, which at the start involved traveling by air to sell cosmetics for several firms. Subsequently she became the only woman to compete in the Bendix transcontinental air race, which she won from a field of men. She took part in a London-Melbourne race but was forced down. On one occasion she brought a burning plane to earth from 12,000 feet. In 1936, she was married to Floyd B. Odlum. Withal she is distinctly feminine. The story is that when she arrived in England after piloting a bomber across the Atlantic she refused to be photographed until she had tidied up and changed from slacks to something frilly.

END

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I Learned About Flying from That!

(*Continued from page 68*)

bly tired. I had done much harder flying in my time, but for some reason or other the combination of rough air and the strain of the day's events made it doubly fatiguing. I felt that I had worked hard for every dollar I was paid that day. At one point conditions got so bad that the taper wing couldn't be used any more for pictures. I rolled out my 37 h.p. *Cub* and flew it, thinking the photographers would find it better for aiming their camera. In the turbulent air conditions, the little ship bounced around like a kite but did its job well.

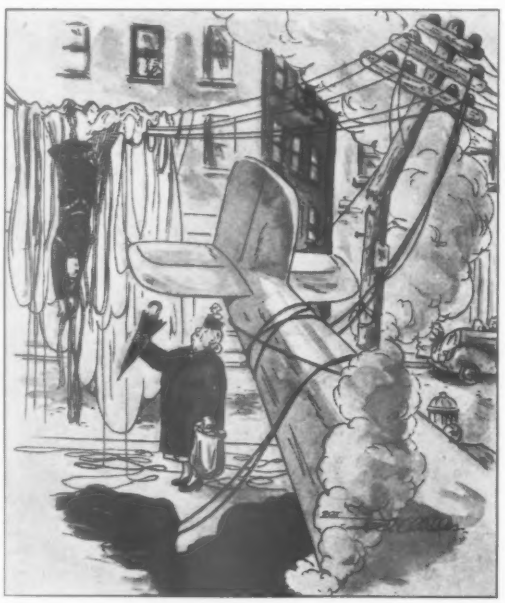
As the results of the wind storm became known, it developed that Charleston was completely separated from the outside world. All telephone lines were down, roads and highway lines were blocked with fallen trees. Early in the afternoon one of the press associations contacted me and wanted me to rush pictures of the damage to their Atlanta office. I felt at first that I couldn't do that. I was tired and nervously exhausted from the flying I already had done. There was no way of knowing what the weather west was like because all communication lines which fed the airport teletypewriter were down. I felt like sitting this one out. Besides, it would be nearly dark by the time I arrived at Atlanta. They kept insisting, however, and what with a feeling that I ought to do it and a very high offer for the trip I finally decided I should try it. I was to leave Charleston at about four o'clock. This would get me in Atlanta about dark. The weather seemed to be clearing but in looking back I realize now that that had been only wishful thinking. As I waited for the pictures to arrive at the airport I was told that I had to stop by way of Columbia, S. C., to leave some of the pictures. Since this was just a little out of the way, I agreed to make the stop.

When the pictures actually arrived it was already getting dark. I had practically decided to give up the trip for it would be pitch black before I could get off. Then I thought it over. I was the only means of getting these pictures to the outside world. I had agreed to take them. I had to go. This was the lesson about flying which I was soon to learn so forcefully. Despite the urgency of the mission don't let common sense and judgment be overcome.

It was after 8 p.m. before I finally took off. I was flying the taper wing, which was not equipped for instrument flying nor, outside of navigation lights, for night flying. Since the ship was primarily an acrobatic plane, not even the compass was accurate. The air speed indicator was about 40 miles off as well. I had only an altimeter and the compass to fly by. The oil pressure gauge was just about as helpful for instrument flight. But I felt I could make it. I had done a lot of night flying in tough weather when I was a pilot on Eastern Air Lines, so night and bad weather in itself weren't new to me.

Just before leaving, Charlie Robertson, assistant airport manager, half jokingly suggested that I wear a 'chute.

"No, I don't need one tonight," was my reply. "I'll never get high enough to use it." But he insisted and just to keep from looking foolish if anything happened I put on an old eight year old Irvin which I had bought second hand the week before for $35.



"Young man, the National Power and Light isn't going to like this. . . .!"

I decided that with the inaccurate compass it would be impossible and foolish to try to fly a compass course to Columbia hence it was my plan to pick up the highway and follow it all the way to Columbia. The take off was as good as might be expected under the circumstances. The tenseness built up in waiting all that time for the pictures, went away from me as the Waco left the runway and bored into the blackness. I was aloft and at home in the air, despite the foul weather. To see my instruments I had a flashlight which I let rest on the seat beside me when not in use. Shortly after leaving the ground, I noticed what few lights there were ahead of me blur out, indicating that I was already in the stuff and that the ceiling was close to the ground. A hasty glance at the altimeter showed that I had about 300 feet. It didn't take me long to think that maybe I'd better get back on the airport and forget about the five hundred bucks or so which this trip would net me—if I made it. I felt more certain of this, when a few minutes later the lights disappeared completely. Gradually easing down, I made a turn to head back toward the airport. But then the highway became clear and I could see the lights again.

The feeling that I had to "get through" came back strong when the lights showed up again so I turned along the highway, headed again for Columbia, 95 miles away. By staying low I could barely make out the general outline of the highway which showed itself slightly lighter than the pitch black swampy forest which is on either side of it for 20 miles out of Charleston. Occasionally there would be reassuring light from a car on the road, but since the highways were pretty well blocked there was scarcely any traffic to help me.

Because of my initial experience in getting into the stuff even at 300 feet, I didn't dare get any higher than necessary to clear the tall pine trees. Then something else started worrying me. I remembered from d r i v i n g along that highway that there was a 150 foot fire look-out tower along the route and I could not remember exactly on which side of the road it was nor where it was located. All I knew was that soon I'd have to get by the tower and I didn't dare get far enough from the highway to leave a good margin. I never did know when I had passed it and it wasn't until I came to a fork in the highway 40 miles from Charleston that I was certain I had gotten safely by that obstacle. The strain and the anxiety of flying the airplane and the certain expectancy that I would suddenly get caught in the scud made all sensation of time and distance disappear. It seemed as though I had been flying all night before I got to the first fork. Then I suddenly realized that for some strange reason I had taken the wrong road and it was necessary to retrace my steps to get back on course.

At Orangeburg I was faced with the problem of sticking to the highway which went directly through the city and keeping high enough to miss the buildings, one of which I knew was a seven story affair. I gradually eased the ship up, for I had been flying between 100 and 200 feet off the ground, and to my pleasure found the ceiling had apparently lifted. It was impossible to look at the altimeter much because I didn't dare take my eyes off the lights and vague outline of the road. I guessed that the ceiling was at least 600 feet and the visibility had improved. This lead me to the false hope that the weather inland might be better and possibly Atlanta would be in the clear.

I roared on over Orangeburg with this "improved" weather but it was still so low that friends there told me later that they rushed to the airport to light the field, thinking I was in distress. It was not long after passing Orangeburg and

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☆ To bring Peace to this mad world, we are sending our Bombers over the "Land of the Rising Sun", manned by American boys protected by 'chutes made of silk.

Our entire production of parachutes is being devoted to the service of our Armed Forces. Before the war Switlik 'chutes were used by the majority of pilots in the United States, and we are preparing now to accommodate the requirements of a tremendously expanded aviation industry after the war.

How?

By constantly redesigning and improving our 'chutes; by incorporating more safeguards, finding better materials, developing better workmanship and lowering the cost. Our specifications are now, and always have been, more rigid and exacting than even those laid down by the watchful Civil Aeronautics Authority.

So, when the last battle has been won, you will find us prepared to meet the needs of America's new army of peacetime pilots.

Faithfully,

Stanley Switlik
President

FIVE REEL SOUND FILM 16MM—"Parachutes for Safety" may be had for a one-day showing by flying schools and colleges upon request. This unusual film describes the manufacture, packing, service, maintenance and use of parachutes. Write on letterhead to Switlik Parachute Company, Trenton, N. J.

SWITLIK PARACHUTE COMPANY

AMERICA'S LARGEST MAKERS OF PARACHUTES
TRENTON, NEW JERSEY

when I was encouragingly close to Columbia that I started running into rain which kept getting harder and heavier. Up to this time, that had not bothered me much but now it got very menacing. It blurred my goggles but when I raised them the rain got in my eyes. Added to that was the fact that my ship had short exhaust stacks and the bluish flame made a glow, light enough to blur visibility to nothing beyond the nose.

It was at this point I started realizing what a predicament I was getting in. The visibility was not only getting worse but my vision was getting down to where I could hardly see anything. For the first time the strain of the days events and activity began telling on me. I suddenly found myself fatigued and weary, because of the flying I had already done that day. I had been out less than an hour on this flight but the terrific strain on my eyes trying to see the thin ribbon of the highway was already getting too much for me. Added to that was the fact that the taper wing was not a very stable airplane and kept me right on my toes to keep it straight and level. I was getting tired, scared, but as yet not panicky.

As these grim thoughts raced through my mind, things started happening. Gradually (not suddenly, as one might expect) I found that I could no longer see the road. The outline of the highway never had been more than a vague sort of gray against the blackness of every thing else and it took a little time to realize that I actually couldn't see it any more. It was a second or two later that the panicky realization rushed into my mind that I was in the soup and had been for sometime. To say I wasn't scared would be a lie. I had had enough instrument experience to know that it was suicidal to try to fly in the soup without all the modern aids to instrument flying available. And here I was without even a good air speed indicator! Despite these thoughts I knew I'd have to turn back; that to go on would be impossible.

I guess I got the airplane in some kind of a turn when to my amazement and horror I saw a light, apparently on the ground but above my top wing! This meant I was in a steep diving turn. As quickly as I could I righted the ship by the aid of that light on the ground and I shudder to think how close I probably came to the trees as I made that recovery. Hardly had I gotten the ship back level when the light and ground disappeared again. All I could think of doing now was climb with the hope that the ceiling might be thin and that I could by luck keep the ship under control until I got on top. It was then that I thought first of that eight-year-old Irvin which I had strapped on at the last minute. If I got on top and couldn't find a hole near Atlanta, I could bail out.

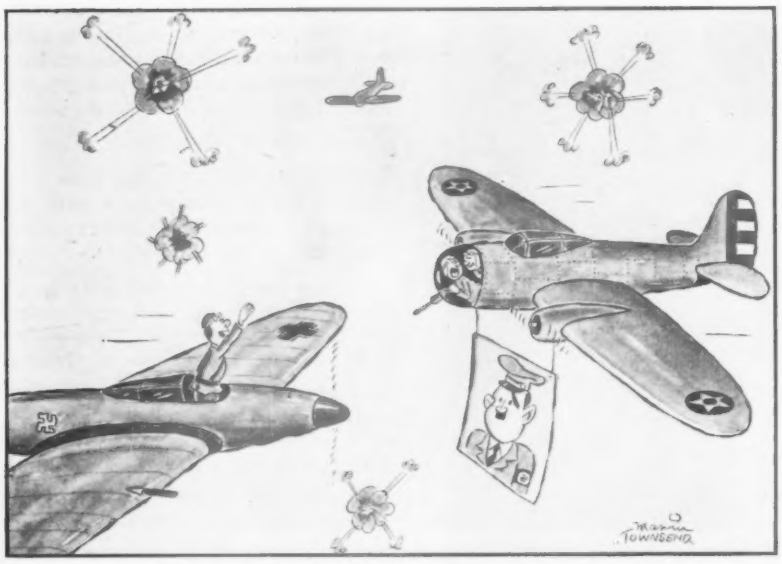
I put the ship into what I thought and hoped was a very gentle climb with a safe margin on the air speed. The ship seemed to be under control and climbed for about a minute and a half when suddenly it started doing something which I didn't recognize—it was out of control. I estimated that I couldn't have had more than 400 feet and had to make the split-second decision to bail out now because I could never get the taper wing back in level flight from that altitude. I was tired and worn out. I gave up.

As I look back on it I marvel at how fast the human mind and body can work when it has to. I recall unbuckling the belt, feeling the 'chute catch under the cowling of the cockpit and then feeling the ship settle out from under me. I half felt, half saw the rudder miss my foot by a bare six inches. If it had hit me I would have been knocked cold. I had made several exhibition jumps before but realized this was no time to count 10 before pulling the rip cord. The canopy popped open instantly and immediately I felt a calm and a relief come over me. I was absolutely fatigued, weary and spent. My first thought was that I had forgotten the flashlight and how much I wanted it as I descended. The 'chute had opened while I was still in the overcast which had a certain greyishness to it. But it was not a second before I had floated down out of the fog into jet black darkness. The first thing I saw was the top of a pine tree dimly outlined against the sky and I was already below its level. I settled into the middle of a grove of trees, my 'chute catching in a branch but not before I had landed in a heap on the floor of the forest. I was too tired to even think of whether I was hurt or not. I must have lain there several minutes without even moving.

I delivered the pictures to the Columbia newspaper office that night, having been located in good condition by natives of the region. The ship had dived into the ground and was a complete wreck, which I later sold for $15 as junk. They had driven me the 22 miles to Columbia, where I arrived shortly before midnight, the crash having taken place a little after 9 o'clock. I strolled into the newspaper office with the pictures undamaged in one hand and my parachute wrapped up under my other arm. Hardly noticed, I left the pictures at the city desk and sat down at a phone to call Atlanta and advise of my mishap. A rewrite man pounding on his typewriter gave me an occasional look of disinterest, then suddenly jumped up and excitedly pointed at my parachute. "Did you use that?" he fairly screamed. It was the first time he'd had a story dumped in his lap like that.

It made a good story for the papers the next morning but it was an expensive lesson for me. It cost me the price of a good Waco taper wing to learn that despite the importance of a flight it is sometimes better to cancel out. It proved to me further that too much flying in one day will wear a pilot out and fatigue him to the point where he can no longer rely on his better judgment and flying ability. I learned my lesson the hard way.

END



"See? When they stand up to say 'Heil Hitler' we blast 'em!"

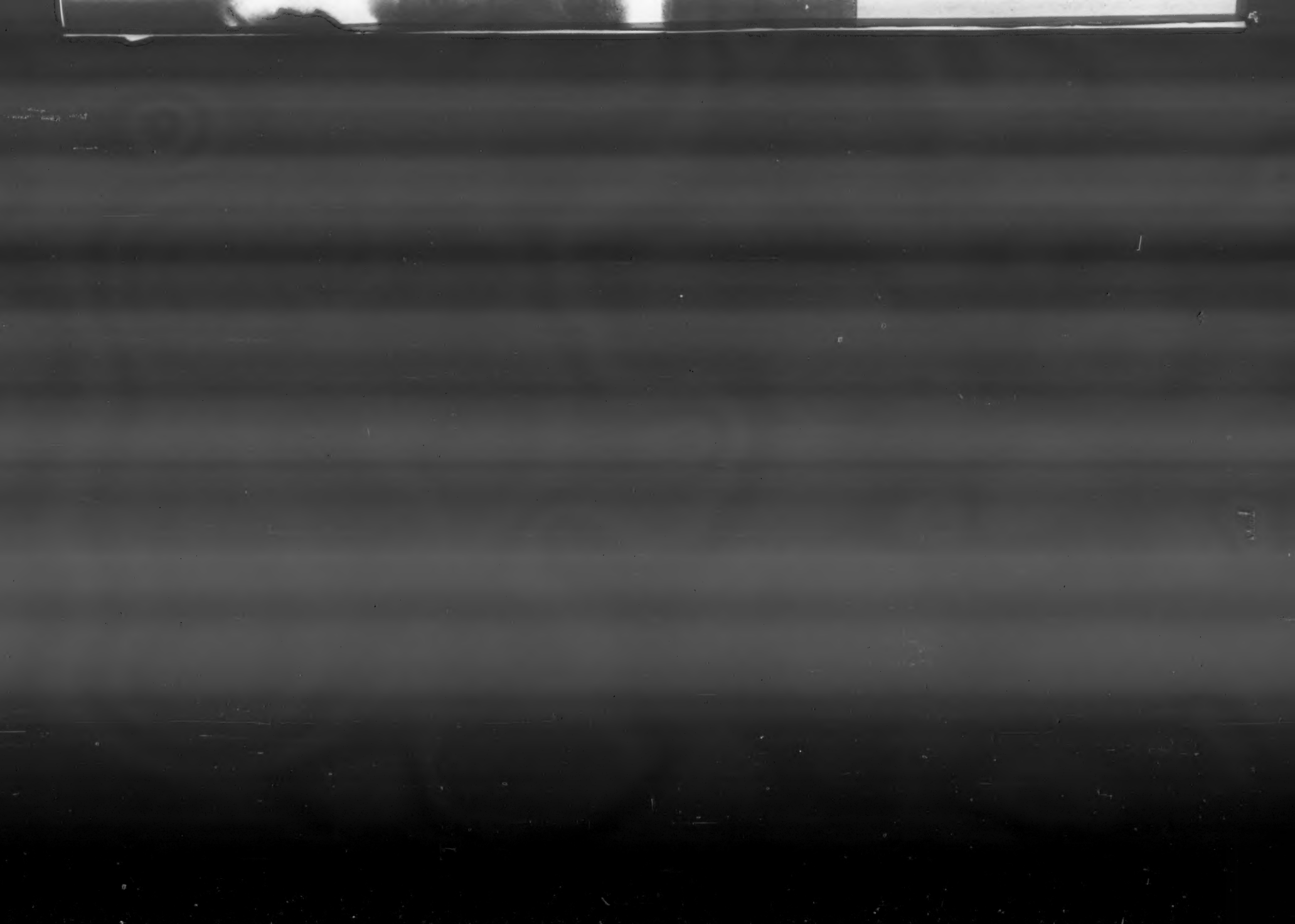
Volunteer Workers

BRITAIN'S first volunteer war factory, where no wages are paid, is in full swing in a small Sussex town. Fathers, mothers, school boys, grandparents—anyone over or under the draft age—work side by side turning out munitions.

The idea was launched by a local Rotary club. Within 10 weeks a factory had been completely equipped at no cost whatever. A building, drilling machines, benches, jigs, tools and fixtures all were donated. Transportation and lighting are contributed by local interests. The plant already has turned out more than 100,000 bomb parts.

Airline Trains Pilots

A NEW airline pilot training program is being conducted by Pennsylvania Central Airlines at Woodrum Field, Roanoke, Va. Candidates are selected from graduates of the CPTP, and facilities provide for training 40 pilots monthly.



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Tomorrow, from the same skies—brightened with Peace—will float farm-fresh dairy products, fruits and vegetables . . . mail and express . . . from giant cargo ships in too much of a hurry to land for the conventional type of unloading. And these parachutes, too, will be equipped with special Joyce-made fittings to insure safe landings F.O.B. the Sky.

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Air Cargo Problems

(*Continued from page 48*)

thors and several cargo and express surveys agree, that speed is also of prime importance to the shipper. Block to block time for a cargo plane must be kept comparable to the passenger plane. Cruising velocity of cargo planes must be then increased if the cargo airplane is to make more frequent stops.

Trip length may differ between a passenger transport and a cargo transport because of the importance of getting passengers through with minimum interruptions. Cargo would not be affected by frequent stops as long as speed was not greatly impaired. It appears that trip lengths of cargo airplanes in the future can be expected to be from 150 to 700 miles.

For the definition of a cargo plane, as the authors interpret it, it is necessary to outline briefly the equipment as would be used by an operator.

It is believed that a large transport system could be properly equipped to perform its function using equipment as follows:

1. *Long haul* deluxe *passenger airplane* having minimum cargo provisions to handle only luggage and possibly mail.
2. *Medium* and *short haul passenger plane* with *moderate cargo* provisions. This cargo space would be located approximately the same as at present, but having a more efficient design and greater volume. Medium haul passenger loads and light cargo loads justify this unit.
3. Medium and short haul cargo plane with moderate passenger provisions. Functions as major cargo operating unit, but acts as a pickup for passengers to feed the through passenger operation.

The small transport system need only adapt for its operation equipment as specified by (2) and (3) above.

These basic thoughts are somewhat different from what has been usually expressed heretofore for cargo operation, but it is felt that the concept is sound and well worth serious consideration.

As has been previously pointed out, there appears no logical reason for any great variation in general airplane design for the cargo airplane as compared to a normal capacity passenger transport. Therefore, airplanes considered for this work should include the following equipment which is considered definitely desirable: (1) Supercharging equipment, (2) Complete propeller and wing de-icing equipment, (3) Adequate heating and ventilating equipment, (4) 24-V electrical system, (5) Full cabin lighting system, (6) Cargo storage and tie-down equipment, (7) Nose wheel, (8) Flight engineer's station and equipment. (On all planes with more than two engines. On the smaller gross weight airplanes, if a flight engineer or flight mechanic is used, he might also act as flight cargo handler.) (9) Radio, including instrument landing units.

The location of cargo compartments is so involved with the design of the airplane that no set rule can be stated. Generally, the centralization of roomy, accessible compartments near the center of gravity as practicable is recommended. Heretofore, cargo space has usually been that space not easily usable for passengers, fuel, crew, radio or controls. The opinion is frequently expressed that cargo should be stored in wing compartments which would be accessible on the ground. The authors wish to point out that outer wing spaces, where they can be utilized, are better suited to fuel storage or to the housing of permanent equipment. The center section portion of the wing of large airplanes can probably be used to advantage for major cargo storage since it can connect directly with the fuselage space. Neither do the authors advocate the use of the fuselage or the aft section for cargo storage unless they communicate directly with the main cargo space, and are used for special purposes (for example, lightweight cargo), requiring a minimum of handling.

Doors and hatches merit consideration in any airplane design, but in a cargo ship they are probably the most important factor in the control of ground time. Size and shape should permit the easy entrance and exit of packages and mail sacks. This requires the doors and hatches to be located as low as possible with respect to the ground. Approximately square or circular openings are considered most efficient. The present rear cargo door of the DC-3 will take 80 per cent of the present cargo.

Racks and bins should be readily adjustable to meet the needs of the particular operator. In many instances it will be desirable to vary the size of the bins for different flights or trips over the same route. For example, the bin arrangement (and cargo distribution) within the airplane being routed out of New York into Chicago (with intermediate stops) might need be considerably different than for another airplane routed eastward out of Denver and into Chicago. The past practice of providing the biggest possible open cargo space in a given portion of the airplane structure involves a minimum of weight, but it does not promote efficiency in handling and segregation. Compartmentalization can be carried too far, but a moderate and sensible utilization of bins is surely advantageous.

The need for good temperature control, ventilation, lighting and supercharging must not be overlooked by the designer. As stated previously, all of these items must be taken into account in the transport of cargo by air. The need for temperature control is readily recognized because flowers, certain foodstuffs, birds, etc., must be protected against freezing. Other items must be kept cool for preservation. This calls for adequate heating and possibly cooling equipment, the control of which must be automatic.

Supercharging at least a portion of the cargo space will be essential, particularly those spaces where birds or other living creatures may be carried, or where relatively fragile air-tight containers will be stored, which are not capable of withstanding considerable atmospheric pressure differences.

Present air cargo is largely limited to those materials not readily combustible, but experience has shown that the fire hazard cannot be eliminated entirely by such selection. Therefore, one of the designer's chief safety problems will be to provide adequate protection which will permit carriage of all cargo now acceptable to railway express.

The shifting of cargo, during flight through turbulent air, or incident to a

Military requirements have opened a new vista of air freight possibilities. Here a ubiquitous "jeep" is lifted into a Marine Corps Douglas DC-3 for quick movement.

hard landing can create a very serious hazard. Here again compartmentalization and centralization are of definite assistance. In addition, means must be provided for the storage and securing of articles which are unduly heavy, and the shifting of which would likely cause damage to the structure or injury to the personnel. Adequate "tie-down" loops or rings must be available so that ropes or straps can be used to advantage in the larger spaces or where reinforced flooring has been provided for the carriage of heavy articles. If cargo airplanes are to make frequent stops, it is self-evident that they would be subjected to rough air conditions over a greater portion of their flight time, since the greatest amount of turbulence is usually encountered near the ground.

The possible fouling of controls, tubing, conduit, etc., has always been a matter of serious consideration by air transport operators, and the problem will be even greater with cargo airplanes where heavy packages will be handled and where all cargo is likely to be associated with more or less dirt and dust. Therefore, protection of controls, tubing, electrical conduits, etc., must be given adequate attention. They should be entirely enclosed so that material cannot be thrown into them either during loading or in flight. Short circuits caused by damage to electrical wiring constitute definite fire hazards and possible loss of use of radio and electrical equipment. Damaged fuel or oil lines can result in loss of power or control and injury to cargo, and a serious fire hazard can be created thereby.

The cargo plane designer is faced with the necessity of developing an airplane which will not be critical to moderate variations of the center of gravity. In the sorting of cargo and during rapid loading and unloading, it will be impossible to control the center of gravity closely, due to the wide variations in type of material to be carried from day to day. Special provisions will have to be made for the extremely heavy or extremely large parcels, but nevertheless, much ground time will be saved if the need for precise weight distribution can be avoided. This appears to be another valid reason why cargo space should generally be disposed symmetrically about the center of lift of the airplane. The present DC-3 airplane has a fairly good range of balance limits but it is believed a greater spread should be planned for any new cargo design. In the case of the DC-3, fair flight characteristics are maintained for a variation of center of gravity from 11 per cent to 28 per cent of the mean aerodynamic chord.

The avoidance of cramped working quarters for ground or flight crews is essential for efficient handling of material. Present airplanes do not provide this feature. In many cases the crews have to work directly in the cargo compartments, and to be in a stooped or squat position to utilize the space provided. When packages can be worked in only one direction at a time, the rate of loading or unloading is limited to the speed of the slowest individual in a cargo passing line composed of two to four or five individuals. This is reminiscent of the old bucket brigade method of fire fighting and is just about as effective.

The arrangement of compartments, possible standardization of package sizes, ground cargo-handling equipment and storage space, and ground working areas are further items for consideration if a well running, speedy system is to be installed.

Since it is so essential to keep ground time to an absolute minimum, much preplanning of the loading of a given airplane should be accomplished. This may call for sorting bins on trucks and improved methods of identifying and routing of parcels. Possibly the trucks should be provided with cargo compartments similar to those within the airplane so that cargo can actually be segregated and distributed in a manner similar to that it will have during flight. Such pre-planning and pre-arrangement would undoubtedly reduce the possibility of last-minute shifting, and should contribute towards better balance and weight control.

END

AOPA News

(*Continued from page* 56)

rates so that it may be properly recorded and distributed to pilots making inquiry.

It will perhaps be possible to arrange for groups of AOPA members to go by train or bus to airports for the purpose of maintaining their flying skill. This practice has already been successfully undertaken by the AOPA Units on the west coast and its popularity is expected to spread to the east coast. There are very few points on the east coast requiring more than three or four hours ground transportation to an airport where ships and instructors are available. Get up a party now and contact the AOPA Washington office for assistance.

1943 CPT Program

Revised in line with the recommendations of the War and Navy Departments, the Civilian Pilot Training Program for the year 1943, follows, in brief:

Navy trainees—The Navy will furnish enlisted reservists (Classes V-1 and V-5). Upon completion of the course, the majority will be assigned to Naval air stations for further flight training; others to be carried through CAA advanced courses to become instructors or ferry pilots. Apply to the nearest Navy recruiting station for enlistment as Navy V-1 or V-5 reservist.

Army trainees—Available to men between 18 and 37 (those between 18 and 26 are accepted *only* if they are unable to pass the requirements of the Army for flying cadets) to be trained as instructors, glider pilots, airline co-pilots, liaison and service pilots. Subsistence and health and accident insurance will be provided. Wherever practicable trainees will be housed at colleges giving the ground instruction. Flight training will be given concurrently at a nearby field.

The elementary course consists of 240 hours of ground school instruction and 35 to 45 hours of flight instruction; the secondary course consists of 240 hours of ground school instruction and 40 to 50 hours of flight instruction; the liaison course, 240 hours of ground school instruction and 55 to 65 hours of flight instruction; the cross-country course, 108 hours of ground school instruction and 45 to 50 hours of cross-country (day and night) flight instruction; the Link instrument course, 108 hours of ground school instruction and 20 to 25 hours of flight instruction, and 15 hours of Link Trainer instruction; the instructor course, 72 hours of ground school instruction and 50 to 60 hours of flight training; the flight officer course, approximately 325 hours of ground school instruction, 20 to 25 hours of single-engined flight instruction, 21½ hours of multi-engined flight instruction, and 20 to 30 hours of Link Trainer instruction.

Further information regarding enlistment may be obtained through the CAA or at any college or flight school participating in the program, or at the AOPA Service Office, Carpenters Building, Washington, D. C.

Pilots Who Walk

There are today many hundreds of qualified civilian pilots with active aeronautical ratings who have been detailed to non-flying, non-aviation jobs in the armed services. In some cases this is unfortunate but unavoidable; in other cases it is unfortunate and avoidable.

Within the Army there are two courses of action open to pilots who find themselves improperly placed within the infantry or other non-aviation branch. These opportunities (along with the Navy opportunities) are discussed at length in this month's AOPA Section.

The rating of "liaison pilot" is possible to attain by members of the Army who have the minimum of a private license which will entitle them to fly lightplanes in certain types of military work. The "service rating" is available to pilots with commercial licenses, provided, of course, in each instance that pilots can meet the required physical, flight and written examinations.

Recently the Navy sent a number of its officers to CPTP centers to undertake courses which will be their first step in obtaining Navy wings. In most, but not all, cases these Navy men have had previous flight training.

Back to the Army, there is also the opportunity of participating in the rapidly expanding glider pilot's course. AOPA members in service are urged to contact the AOPA office for assistance in ascertaining the proper channels by which they may exercise to the fullest their skill and services as aircraft pilots.

Regarding Your License

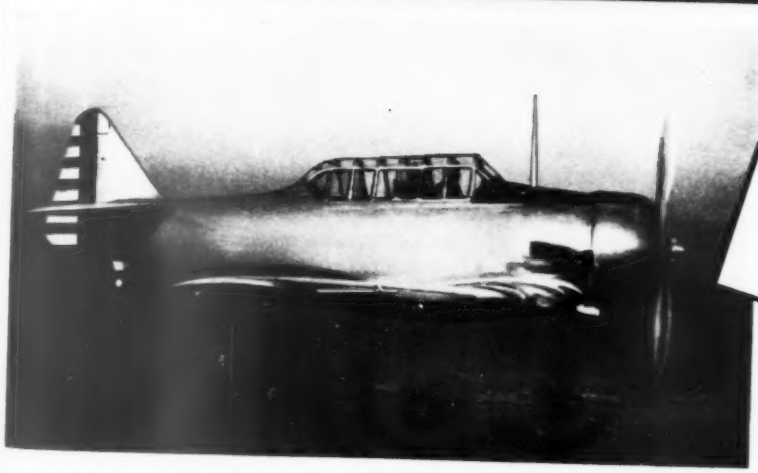
We again urge AOPA members not to despair because of their temporary inability to get in flying time. According to the present Civil Air Regulations, your license does not necessarily lapse because you are unable to get in a specified amount of flying time during any one period.

(*Continued on page* 108)

Design for Victory

From Southern California come North American B-25 bombers. This is the type of bomber which first blasted Tokio.

From Southern California come North American Mustang fighters . . . dread scourge of the Axis Nations the whole world over.



From another NAA plant come North American trainers . . . in which United Nations pilots earn their fighting wings.

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14. Aircraft Materials and Processes
by George F. Titterton. 360 pgs., illus. **$3.50**
At this time of national emergency, the book has been carefully revised to include the latest materials and processes.

15. Airplane Design Manual
by Frederick K. Teichmann. 350 pgs., 170 ill. . . . **$4.50**
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16. Aircraft Radio and Electrical Equipment
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Here is a book written to provide clear understanding of the operation and use of present-day equipment, and beyond that to enable the reader to keep up with the developments which are already clearly forecast.

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Today's most usable, up-to-date information based on practical experience in engine testing, backed by careful research and investigation.

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(*Continued from page* 104)

If you are in doubt as to your license status, write to the CAA or to the AOPA Washington office, giving the number of your license, the type, and the date of expiration as well as the date of your last medical examination.

Do not destroy your log books or your license, for in the majority of cases they are still valid and may be revived with a minimum of difficulty.

AOPA Pilot Wings

The demand for AOPA woven wing emblems has been so heavy that we have just placed a new order. If there has been a slight delay in answering your request, we beg your indulgence as the demand far exceeded the supply. AOPA is making these emblems available to members at cost—25 cents—which barely covers the expense of manufacturing and mailing. Requests for these emblems should be addressed to the AOPA Registrar, Michigan Square Bldg., Chicago.

Airplanes in Cold Storage

For those members who are called into the service or who own airplanes within the Eastern and Western Defense Areas, we call particular attention to the necessity for proper storage and maintenance of ships which are dismantled for the duration.

In this month's AOPA Section considerable space is devoted to timely tips for preserving your airplane while it is out of operation. The manufacturer of your airplane and engine can give you additional data which will save you many dollars and prevent unnecessary corrosion and deterioration.

When you put your ship in storage, be sure and notify your insurance company so that proper adjustment may be made in your insurance coverage to provide for fire, theft and other contingencies. Usually you will be surprised to find that your total insurance bill, even with extended coverages, will be less than the former rates applied while your ship was in active flying operation. The AOPA staff will gladly assist you in your specific problems of aircraft maintenance.

Wanted for Defense

Aircraft transmitters are badly needed by a number of pilots participating in the CAP and other defense activities. High priorities of the military services make transmitter crystals and other parts very scarce. AOPA has offered to act as middleman for all pilots who have aircraft radio transmitters (in good working order) who no longer have need for them. There is a good market available for the sale of these units.

Those having such equipment, including radio receivers with loop antenna direction finding attachments, should drop a penny postcard to the AOPA Washington Service Office, Carpenters Bldg., indicating the type of equipment, age, condition, original cost, and price desired for the article. AOPA will turn this information over to pilots who need this equipment for important air patrol activities. Naturally, AOPA will contribute its time.

Members in Service

Each month AOPA publishes a list of additional members who have joined the armed services. Such a list also appears in this month's AOPA Section. If you are an AOPA member or know of an AOPA member serving in the country's military forces, we urge you to advise the AOPA executive assistant in Washington so that these names may likewise be entered on AOPA's Service Scroll. Pictures of such members are also desired.

Anti-Submarine Patrol

At least 25 merchant vessels have been saved from being torpedoed by Axis submarines, and approximately 250 survivors from sunken ships have been located as the result of the over-water operations of lightplanes by CAP forces.

Lost—15 AOPA Members!

Anyone knowing the whereabouts of the following AOPA members are requested to notify the AOPA Registrar, Michigan Square, Bldg., Chicago, Ill.:

R. M. Sweet, No. 399
Mack R. Carlin, No. 229
Alberto G. Cuevas, No. 7255
Stephen A. Nesbitt, No. 1728
James U. Martinez, No. 174
R. E. Hill, No. 3349
Alice I. McMillan, No. 7120
Sven Kjar, No. 3640
George L. Chedsey, No. 5393
William L. Fly, Jr., No. 1936
John I. Loving, No. 5079
Nathaniel J. Weiner, No. 815
J. T. Tokey Walker, No. 8010
Walter Hodge, Jr., No. 7611
William A. Gilmore, No. 3150.

END

Identification Instruction

AN Army bomber roars off into the night, heads for a given objective, dumps its load of trouble and returns.

Who are the men behind such a job, the men who see that it's done properly? Not just a pilot and a co-pilot, but a team, working in precision and co-ordination. The other members of this team are the air crew: navigators and bombardiers who are trained at Ellington Field, Tex.

A lesson that England has learned "the hard way" is being taught these air crew men. They are being shown that their part in a bombing mission includes more than the vitally important work of getting their plane to the right place and dropping the bombs. The pilot is busy flying the plane. The bombardier, in the glass-incased nose, and the navigator are the best men to do observation work. It is up to them to pick out the bomber's quarry, whether it be an enemy battleship, a munitions factory or some other objective. And, always, to be on the lookout for hostile attackers.

The man who brought the lesson back from England is Capt. L. R. Hughes, executive officer of the Air Forces Replacement Center at Ellington. He and another officer, Capt. W. L. Kieffer, spent six months in England with the RAF, crossing the channel with the British flyers on bombing missions and observing them at their work.

The bombardier and navigator cadets at Ellington learn to identify every known type of Allied and Axis plane and warship: naval, army and commercial. Most of the instruction work is done with models. The men must learn to identify miniature planes and vessels.

END

Clear Thinkers

(*Continued from page* 19)

aces, rode a sailplane behind a blimp in Ohio, and Frank Hawks topped everyone by tailing a Waco piloted by Duke Jernigan from San Diego to New York in less than 37 hours' flying time.

Just as the glider paved the way for powered flight, it also was largely instrumental in starting the lightplane industry. During the epidemic of 1929-30, glider experimenters hit on the use of an auxiliary engine to get their equipment in the air, thereby eliminating the cumbersome tows of the times. The motor was too light to sustain flight for any appreciable time or distance, but it served to get a gliding or soaring enthusiast up high enough to take advantage of the thermals, at which point he could shut his engine off. The "outboards" proved so popular that their horsepower was increased until they could keep going for a number of hours, and the lightplane was born.*

To all these experiments were added others in the last few years, and with Germany the glider went to war. Again the results were spectacular. Banner headlines blossomed with the Crete campaign. Accompanied by fulsome statements about what wonders the glider will accomplish during the conflict and after the peace, it has figured in the news periodically since. The glider will win the war by putting the right troops in the right place at the right time. It will help solve our air freight and troop transportation problem. And afterwards we will see big "engines" towing whole fleets of gliders from, say, New York to New Orleans, dropping a glider off with passengers and cargo at Baltimore, Wash-

* Editor's note: The cycle was completed recently by Mr. Stanton himself when he inspired a glider made from a lightplane. More than a year ago, he suggested that the war-born training glider-building bottleneck be broken by taking the motor out of a lightplane and putting a glider-pilot cockpit in its place. This spring, Army experts still despaired of getting trainer gliders into mass production inside of a year. Stanton turned rough sketches of his idea over to lightplane manufacturers who, working with CAA engineers, brought about mass production of trainer gliders in a matter of weeks. First model was designated by the manufacturer as the CS-1—the "CS" for Charles Stanton. It differs from the conventional "putt-putt" in that it has the new cockpit nose, shorter landing gear legs, no motor, a few strengthening points to accommodate the weight of a third person, and other slight alterations to make towing possible.

people with a PUNCH

The spirit of personal sacrifice and extra contribution to the war effort is typical of Beechcraft employees, and is especially strong among the hundreds of men and women of the Beechcraft Reserve Guard, some of whom are shown in review below.

These employees voluntarily drill and practice in their free time so that they may be ready to meet any catastrophe or emergency that may arise, whether caused by enemy bombing, fire, sabotage, or act of God. They have sworn to protect life, war material, and the plant, in the interest of the war effort. They come from all departments of the Beechcraft organization, serve without pay, and buy their own uniforms.

Other Beechcrafters are members of the highly efficient Volunteer Fire Department, and still others are members of the Employees Club and of the Whiskers Club. These latter pledged themselves not to shave until certain high increases in production had been attained. Their beards are long gone but now they and the members of the Employees Club freely donate their own time to creating benefits for service organizations.

Production figures are the best proof of the devotion of ALL Beechcrafters to winning the war, but cannot be divulged. The next best proof is that Beechcrafters are voluntarily investing, not 10%, but OVER 20% of their total gross payroll in War Bonds! And the next best proof that they are putting their hearts as well as their heads into their war contribution is their grim slogan of deadly earnestness,

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So much for the headlines and the human interest, aided and abetted by one of the most enthusiastic group of sincere airmen in aviation—the gliding and soaring fraternity. Most of them have taken it up as a sport, almost all have gone overboard when they experienced the thrills of flying high above the earth without the roar of an engine, silent as eagles; and there are indeed among them men who, above some lonely peak, have been followed by eagles. It takes men of imagination, vision, and with the hearts of adventurers to become enamoured of such activity, and gliding and soaring has far more than the average quota of them.

But what of the facts?

The facts, I believe, are that we are in the midst of another epidemic.

The glider is a useful instrument of war or peace, but with limitations. It is not an invention of Superman and we must look behind the "stunts" and, without emotion, study the actual statistics.

Take an incident of glider history which was staged recently at Washington National Airport. A three-place glider was towed in by a 215 h.p. two-place Waco and there was much oh-ing and ah-ing about the fact that the plane had brought its "more than double" load from the middlewest at an average speed of 85 m.p.h.

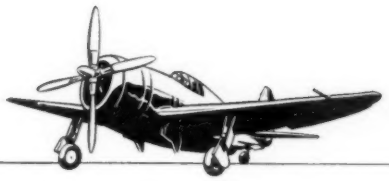
But there is nothing whatsoever remarkable about this performance. A similar job was done far more efficiently by an airplane flying alone as far back as 1923, when a 110 h.p., five-place Bellanca flew at a top speed of 110 m.p.h. and cruised at 90 m.p.h.

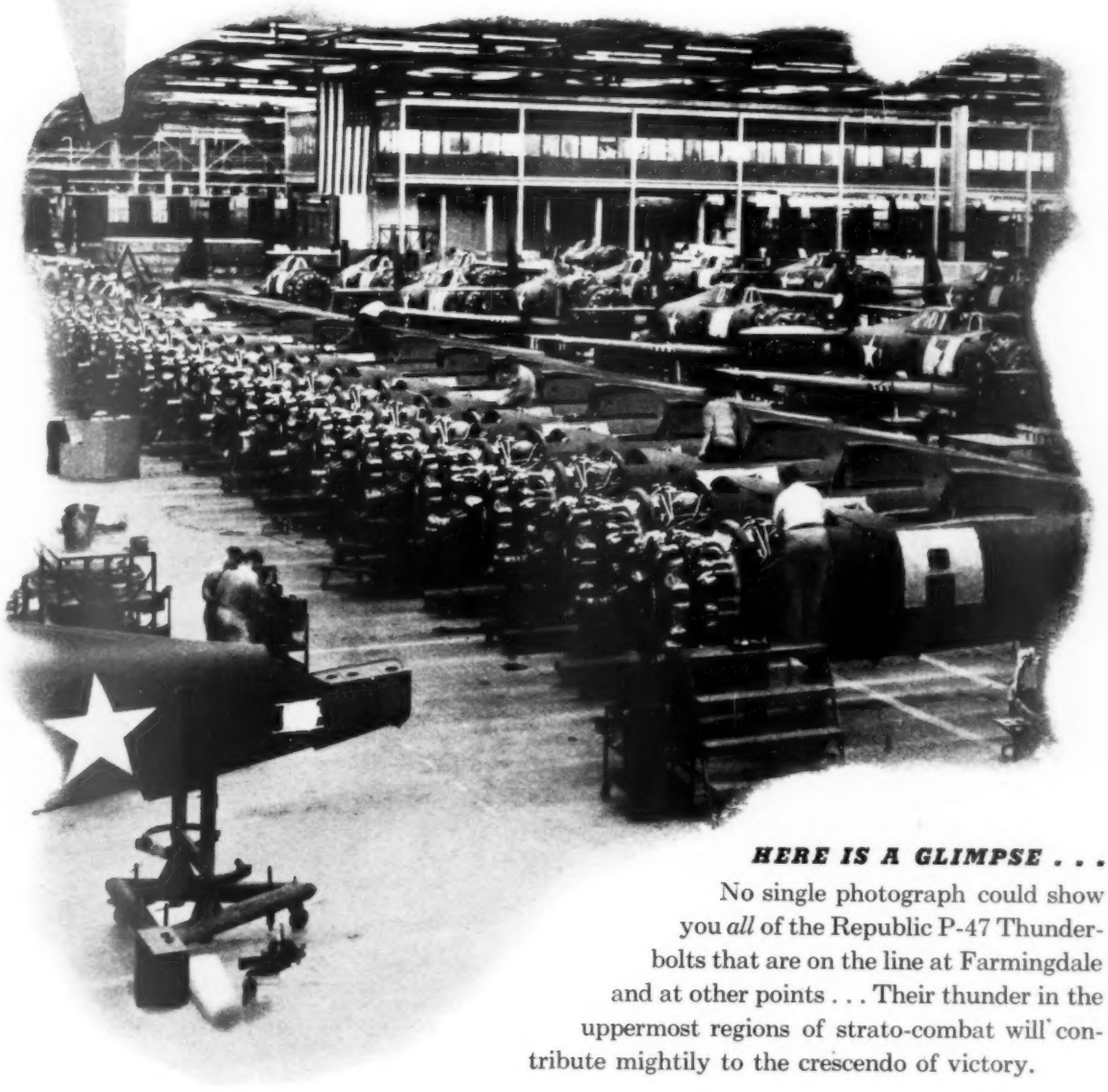
Away back in 1920, there were planes like the all-metal JL-6, which, with a 185 h.p. engine, flew six passengers 130 miles in 59 minutes. Three of the well known workhorses of the 1926-1931 half-decade were the six-place Travelairs, Stinsons and Bellancas with 225 h.p. Wright *Whirlwinds*. People just forget that we have been applying increased horsepower to producing higher speeds rather than carrying greater loads during the last 10 years.

By the same reasoning, when post-war gliding is spoken of as another means of commercial magic, few stop to think that if the tow plane, the "engine" or "tug," is properly designed, it will, according to engineering specifications, be able to carry as much as it tows, and travel somewhat faster, landings at every wayport included. Further, as any airman knows, dead stick landings are dangerous. If you misjudge your approach, you land badly. But, if you have an engine to gun so you can circle and have another try, a crash and its hazards to life and equipment will be eliminated.

Gliders are useful for crash landings in spots where a take-off later would be impossible. Especially in war, they can be used with telling effect on "one-way" trips—for landings on rough terrain, marshes, narrow beaches and on hillsides where, if a plane landed, it could not take off. There are many such places in this war and the gliders that go into them—the men who pilot the silent equip-

OLUME FOR VICTORY





HERE IS A GLIMPSE . . .

No single photograph could show you *all* of the Republic P-47 Thunderbolts that are on the line at Farmingdale and at other points . . . Their thunder in the uppermost regions of strato-combat will contribute mightily to the crescendo of victory.

REPUBLIC AVIATION

REPUBLIC AVIATION CORPORATION REPUBLIC AVIATION FARMINGDALE, L. I., NEW YORK

ment and the troops who go along—all will undoubtedly play dramatic and invaluable roles in winning the war. But to overemphasize the importance of their potential parts is as unfair to them as it is to the gliders. This is everybody's war and nobody can effectively do his part in it without the help of everyone else. In the meantime, it would seem wise to salt down the Superman idea with more than a pinch of horse sense.

Horse sense is needed also in studying the possibilities of post-war gliding. From where I sit, it will not be the spectacular role that its enthusiastic partisans predict. Our airline safety record (the world's best) will undoubtedly be guarded as zealously after the war as it was before, and scheduled "deadstick" glider landings with passengers and mail will probably be as unacceptable to the airlines as to the Government bodies regulating them.

* * *

What is true of gliders is doubly true of cargo planes. Again, we find a highly useful instrument of war and peace being handicapped by ballyhoo.

The proposal to build a great fleet of cargo airplanes to carry our war commerce through a medium not afflicted by submarines is an excellent one. It is in character with American enterprise and its attitude that regards nothing as impossible. That is the attitude that has made our aviation the huge success that it is today. Aviation leaders are the first to approve it. But in all justice they ought also be permitted to review the basic facts in order that we may not get ourselves out on an unsupportable limb.

In the first place, the cargo plane idea is not a new one.

On a scale far larger than any of us realize (we are at war and we are leaning over backward not to tell the enemy anything that will give him aid and comfort) cargo planes are already doing a magnificent job. Headquartered at the CAA's Washington National Airport, the U. S. Army's Air Transport Command, under Brig. Gen. Harold L. George, has cargo planes flying at all hours of the day and night, over the seven seas, to every battle front.

Its pilots flew emergency equipment to MacArthur in Australia. It flew a complete hospital to Alaska in 36 hours. Its planes are flying on regular schedules, loaded to the guards, to almost any United Nations capital you want to name. Seventeen of the nation's airlines, operating under the ATC, insure efficient operation. Big planes pouring off the assembly lines insure an ever-expanding future. Cargo planes aren't on the way. They're here, right now!

This is not to say that we cannot use bigger and better ones, but it is to say that we must avoid headline hysteria in studying the problem.

During the current discussions, for example, I have been surprised to see no mention of the most important factor in the supercargo airplane controversy—the fuel problem.

Fuel is cargo, and heavy cargo at that. Sikorsky points out that the weight of the S-42 *Clipper* engines is approximately 4,270 pounds, while the weight of enough gas to take the big boat 3,000 miles is more than 16,000 pounds.

We do not have accurate figures on the Martin *Mars*, but such figures as we do have indicate that its percentages of empty weight, fuel load and payload are no better than those of the Boeing *Clipper*, with regard to which we have very complete figures and plenty of operating experience. The only difference would seem to be that by using an airplane the size of the *Mars*, fewer units would be required to carry a given tonnage.

A cargo plane, flying to England, could fuel up here without difficulty; fuel to get it back, at least today, would have to be taken from here in ocean-going tankers.

If operating with a gassing stop in Newfoundland, a *Clipper* could carry eight and one-half tons of freight to England.

One 10,000-ton surface freighter can carry an 8,000 ton cargo, together with fuel and stores for the round trip.

Thus, some 941 *Clipper* trips would be needed to carry the 8,000 tons which could be carried by one 10,000-ton waterborne freighter.

However, 8,500 tons of gasoline must be carried to England to get the *Clippers* back to Newfoundland, and 10,500 tons must be carried to Newfoundland to fuel the *Clippers* for the cargo trip to England and for the balance of the return trip, Newfoundland to New York. Thus, more than two surface freighter loads of gasoline must run the submarine gauntlet to Newfoundland and England to permit the cargo which one would carry to be flown across. This would more than double the surface vessel cargo tonnage requirements, increase exposure to submarines and add considerably to the convoy problems.

Fuel supply being the problem that it is on most of our battlefronts, it would seem to follow that for every air freighter we build, we would have to step up provision for increase in the construction of sea-borne tankers, rather than divert materials and manpower from surface ship construction to cargo airplane building.

In the meantime, the industry and other American experts have not been sound asleep—and the public should know it for their peace of mind. The industry, as much as (if not more than) any other, is out to win this war and it is doing everything that it possibly can to that end. Perhaps its shortcoming has been that it has avoided the headlines.

A cargo fleet is highly important for emergency and high-value cargoes. It is important to the war and to the peace that will follow. Sound judgment, based on the existing facts and avoiding stratospheric prophesies, shows today that tomorrow all oceanic business passenger traffic, mail and express cargoes will be handled by air. A majority of overland traffic in the same categories will be flown. But there is no point in stretching these facts. To do so is to over-sell aviation at the risk of running counter to the facts and rousing the enmity of partisans of other forms of transportation. This is the last thing that we should do, particularly because we know that increased air traffic will bring a boom in surface cargo traffic—if for no other reason than that the surface craft will have to haul the fuel to keep 'em flying. Far from stealing the show, aviation will be a helpmate for all forms of transportation. And the sooner we get this straight in our own minds as well as the minds of the general public, the better for all concerned.

Cargo planes, like gliders, are undoubtedly playing a leading role in the war effort. They will continue so to do after the guns have ceased firing. But today, as much as on cargo planes and gliders, it would seem that we should put a high priority rating on a large order of cool calculation.

END

The Aeronca "Defender" (above) and other lightplanes were converted into gliders, at the suggestion of Mr. Stanton, thus saving the Army's glider training program.

Streamlining Regulations

THE Civil Air Regulations are being streamlined to speed war and post-war civilian flying, Charles I. Stanton, Administrator of Civil Aeronautics, reports. "Although he is now burdened with new regulations made necessary by war-time conditions, the private pilot, along with other airmen, can take consolation in the fact that recent progress toward simplification of the CAR will save many hours of time formerly spent doing business with CAA inspectors," declared Mr. Stanton.

STRANGE BIRDS ON THE HORIZON

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WACO AIRPLANES

Flying Safety in the Army

(Continued from page 32)

costs money, and delays, by however small a margin, the final settlement with the international bandits with whom we are at war. An airman with a broken leg, quite apart from his own suffering, is of no use whatever in a Battle of Midway, or a raid on New Guinea, or a bombing of Tokyo. And a fatal accident is a tragedy that distresses every person in the organization. Americans are not militarists practiced in brutality, and a needless death is not regarded as a matter of course.

The human factor being considered, it was perhaps inevitable that the total number of accidents should increase with the mushrooming of the Air Forces. To keep their number at a minimum, and to check any tendency for the accident rate to climb, the Directorate of Flying Safety was established as an outgrowth of a former branch of the Inspection Division.

The new organization operates under the Director of Technical Services of the Army Air Forces and its function is to surpervise inspection and investigation of conditions, practices and facilities which may affect flying safety, to study accidents and the system of reporting on them, to instruct personnel in safety practices and see to it that the safety code is observed.

Technical knowledge is used in a psychological approach to the task of preventing accidents, since the only reason for determining what caused an accident is obviously to pass the information along to the airmen so that the same thing won't occur another time.

Human failure is the basic problem of the entire safety program. Less than 14 per cent of our current flying accidents can be attributed to mechanical difficulties. If the equipment is not to blame, then it must be the man handling it, and thus we find that research actually discloses that a predominant number of accidents are due to the inexperience of younger pilots.

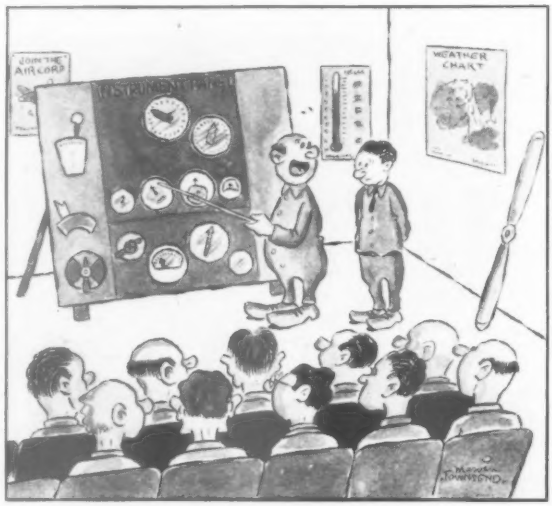
An experienced flyer is involved in accidents only on very rare occasions, because a pilot with a long record in the air knows the importance of taking precautions which will help him to avoid conditions and circumstances likely to result in accidents.

The splendid safety record of our Army airmen was established and improved year after year because a progressively larger proportion of the flyers had accumulated the knowledge that comes with experience. What may appear to be instinctive action on the part of an experienced pilot is more than apt to be the assurance derived from thousands of hours at the controls of airplanes.

With the expansion of the Air Forces, the Army was faced with a condition in which thousands of young and inexperienced pilots were being added to the rolls, and they were using high performance equipment. How to protect them from the dangers implicit in their lack of experience?

That was the question, and the answer is to translate the knowledge of experienced flyers into rigid regulations, telling them, meanwhile, through every available instructive device, why the regulations were adopted, and insisting that they be followed.

Following the establishment of the central agency for this task at Air Forces headquarters in Washington, 10 regional safety offices were set up to facilitate research and contact work. Regular Army and Reserve officers with a broad background of accident prevention make up the field staff, and their job is to investigate every accident, correct dangerous or lax practices, and promote, among pilots, students and instructors alike, the general idea of safety.



"That's fine, Arnold. And now that you have yourself flying straight up at 300 miles per hour with the motor cut off—what do you intend to do?"

Classroom lectures, individual personal advice, posters and other graphic presentations of "do's" and "don'ts," including special motion pictures prepared by the Flying Safety Directorate itself with the aid of technical experts—every means that can possibly contribute to the end purpose of the program is utilized.

The safety program stresses that every accident lowers the striking power of the Air Forces, diminishes America's ability to "hit 'em and hit 'em hard, wherever and whenever we can." The avoidance of preventable accidents, therefore, is not merely desirable—it is a paramount duty of every officer and enlisted man in the Air Forces.

Under the terms of the Flying Safety program, any member of the Air Forces can be disciplined for infractions of the safety code. And that means exactly what it says—any member of the Air Forces, regardless of his rank. Not only can they be disciplined, but they will be, promptly and severely.

Stressing the paramount need of passing along to young pilots the accumulated experience of their elders in the form of regulations and advice does not mean, of course, that the Directorate of Flying Safety devotes its entire attention to pilots.

The mechanical side of the problem gets its full share of attention. If, while checking the accidents attributable to human failure, the Army can also reduce the 14 per cent which can be traced to mechanical faults, that will be done, too. Load factors and all the multitude of mechanical safety problems involved in the operation or ferrying of long-range combat, cargo and other military aircraft are studied carefully, and appropriate regulations prepared on the basis of these studies.

The greater proportion of this work, for readily apparent reasons, is done at the Materiel Center at Wright Field, where the painstaking and exhaustive studies and experiments of Air Forces technicians have built up an enormous reservoir of knowledge for application to the problems of mechanical safety.

Nearby, at Patterson Field, is the headquarters of one of the 10 safety regions, under Captain E. N. Townsend. The other regions have their headquarters at Mitchel Field, Bolling Field, Savannah Air Base, Ga., Maxwell Field, Duncan Field, Mines Field, Calif., Oakland Municipal Airport, Calif., Geiger Field, Washington, and Will Rogers Field, Oklahoma City.

From these, the Regional Safety Officers forward to Washington detailed reports on all accidents in their regions, including information on the cause, nature, the extent of damage, and injury to personnel. These independent studies and reports supplement the established method of inquiries by boards.

Tabulated and analyzed by the headquarters staff in Washington, these reports form the basis of directives and regulations issued by the Director of Flying Safety to establish uniform flying safety practices at all Army fields.

By the exercise of such constant study and vigilance, the Air Forces hope to restrain the over-eager behavior of such a one as Floor Board Freddie, who, as posters on the walls inform pilots,

". . . would always say
" 'It don't hurt it none to fly it this way.'
"He'd give the needle to maximum goose—
"They never found out what first busted loose."

That's one sample of deadly-serious

kidding which is used in posters to remind the boys that safety regulations are not just the over-cautious orders of old fogeys who have forgotten that it's fun to fly, but the sensible maxims of experience. Another like it, with an illustration in which the offender is hidden behind a hospital door displaying a "No Visitors" sign, relates how

"This callow clam, still twenty feet high,
"Sat stalling it in without batting an eye
"Or using his throttle to ease him on down—
"The flight surgeon says he'll recover, the clown!"

To save his neck, the young pilot will be kidded, bawled out, instructed, helped, advised—any psychological approach that promises to make him careful without breaking his spirit will be used.

The Army wants him to be a hero, but it won't give him a medal for cracking up in some dizzy exhibition or for knowing-it-all to the extent of carelessness. He's got to hoard his heroics until he meets a Jap, and then—but only then—he can shoot the works.

END

Alaska Adventure

(*Continued from page 34*)

vance, and then recording the time between each point while in flight, we could quickly use the Dalton (Mark VII) computer to determine our ground speed and know if we'd make Telegraph Creek with our gas supply and winds as they were, or if we should turn around and head back.

The check points also aided us in finding the proper compensation for wind drift to apply to the compass. For the first half hour we experimented with different headings within 15° of the magnetic course, until we seemed to find one that worked. Having long Stuart Lake stretch continuously in the right direction at the start was a great help. Then when we came to lonely stretches of 50 miles or more without checks, we would trust the compass heading as last computed, estimate our time by our previously computed ground speed, and stretch our eyes for landmarks.

We didn't dare to miss one of them. There was no comfortable radio beam to hum in our ears here. And the map, though accurate in its waterways, was a far cry from U. S. aeronautical charts. You might call it a road map; it would have been that if the region had had roads or railroads to put on it. This area was singularly unblessed with such signs of civilization, however.

The fact that the map was scaled 27 miles to the inch when we were accustomed to the detail permitted in 8 miles to the inch, and the fact that it showed no mountains whatever added to our mental discomfort. We guessed that there must be mountains by the way the rivers ran and the lakes lay and from talking to people. How high they were, we were to find out as we flew!

We had determined a compass heading of 300° by the time we crossed a side arm of Stuart Lake; also we'd determined that 9,000 feet of altitude would be more comfortable than 7,000. The mountains weren't low.

Takla Lake was one checkpoint and on our map, a facetious Canadian had noted for it, "Landing Only." We, too, wondered how any pilot possibly could get an airplane off that particular spot when we saw it.

Till this point our ground speed had been discouraging, partly because of the time lost in climbing; however, from here on it zoomed to the 90 m.p.h. range—good enough to make the jump on our gas with accurate navigating.

Several times we'd wonder which river to follow. We'd make a trial run up one, checking our compass for its direction—always adding 30° to make it jibe with the true-north direction on the map. Often an initial curve, ignored on the small scale map, would throw us off for a few minutes. Once we could see the general pattern of the river's course, we'd decide whether it was okay, or whether the one a little farther south was correct. How gratefully we noted tributaries showing up according to schedule after we'd chosen the "right" one!

Gene wobbled away at the little pump to transfer gas from the cabin cans just as fast as the indicator in the main tank went down. He soon discovered that he could wobble through

Photo by U. S. Army Signal Corps.

Vital Link in the Victory Chain—Sensitive, Rugged Microphones

He seldom gets a hero's mention, but the "man with a mike" plays a mighty important part in modern war. Along with the pilots, bombardiers, gunners, and men with more spectacular roles, he is in the thick of every fight. His chief weapon: a small, compact, supremely dependable microphone—a vital unit in his supply of communication equipment.

Kellogg Microphones meet the high performance standards required for military use: excellent sensitivity; great resistance to climatic changes, shock and hard usage; accurate transmission of voice frequencies; etc.

Kellogg invites prime or sub-contractors of the U.S. Government to consider this company as a source not only for microphones, but also for the many other types of communication equipment for military use which this 45 year old firm is equipped to manufacture to specifications.

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A Few Examples of Kellogg Products for Military Use

Some of the numerous types of precision equipment which Kellogg makes for military use are shown here. These include hand, throat and palm microphones; telephone and radio earphones; control boxes; multi-contact plugs and sockets and many other items directly associated with radio and telephone communications.

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FOR WAR AND PEACE

a gallon every seven and a half minutes . . . just an hour for our eight gallons.

While he wobbled, I struggled with the Morse code. We'd arranged with the Prince George radio to code our position to them on every hour when they would especially tune in on our transmitting band of 3105 kc. Our radio set wasn't powerful enough to transmit voice beyond 50 miles, but the code should have gone through. I'd carefully check our position, wrestle with dots and dashes to express some of the lovely Indian names used in that country for rivers and lakes. Alas, by the time I was ready to send, we'd have gone many miles beyond the spot! (And then Prince George told us on our return that they hadn't heard a buzz anyhow!)

With the wobbling, code-sending, flying and navigating, we had our hands full. After three and a half hours, we were beginning to be a little uncomfortable in the small cabin, too. Then when checkpoints didn't tally, we became mighty worried. Clouds were forming on our left and lowering to mountain tops. The course of the river we had selected last, however, still corresponded with the compass course, so we kept on straight ahead and hoped.

It was a relief to find a lake and river ahead that jibed with one on the map . . . even though we groaned as we realized that it was still 120 miles from Telegraph Creek. We clung to that Big Klappan river for dear life. Finally, we picked up the Stikine River on which Telegraph Creek was located some miles below. When I spotted six huts on the bank, I wondered if we were missing the town? But I had a little diagram of the town and airport (drawn by a bushpilot) and a description. It read:

"A longish narrow town right next to the river, behind which is a mountain, on the other side of which is the narrow field used as a landing place."

Was it a thrill to find such an arrangement 10 miles farther on!—five hours from Prince George!

We were still at 9,000 feet and had to come down a long way. We circled and dived and generally wing-dinged our joy at arriving. Gene finally was low enough to drag the field looking for danger spots. Then he went around the mountain once more and came in for landing.

"Safety belt tight?" he shouted.

"Okay," I answered.

A quiver, a bump, and we were down. Whee!

We were just in time to see a Culver *Cadet* that had preceded us by one day crated up ready to go down the river by boat. It had completely cracked up on the take-off that morning. Oh, the field was tricky. In addition to a growth of nine-inch poplar seedlings covering it, it had a strategic bump half-way down. You took off on that bump or you didn't get off.

Our reception at the next stops . . . Atlin, Whitehorse and Dawson in the Yukon territory, and finally Fairbanks, Alaska . . . was warm. Officials keeping close check on our progress worried when we didn't appear out of the Telegraph Creek wilderness on schedule because weather delayed us. Only seeing us and our plane for themselves convinced them we were all right. Incidentally, the only objection we had to Atlin and Dawson was the price of gas . . . $1.10 a gallon!

Alaska was wonderful. The hospitality of Fairbanks warrants its title, "Golden Heart of Alaska." We went down to Anchorage, spent a couple of days in the Wisconsin-like Matanuska valley of farms and dairyland; saw the three rugged crags of 20,000 foot Mt. McKinley, highest peak in North America (an impressive sight when the sun illuminates its glacier formations); and even soared up into the arctic circle to the Indian post of Fort Yukon. On these trips, for the first time, our friendly good weather seemed to abandon us. But it was mild compared to the "soup" we encountered coming home!

Many times, as we flew south again, we wondered if we'd get home. We'd heard how swiftly the weather changed in this area. We found it very true. Starting out on a perfectly clear day at dawn, we were invariably grounded by mid-morning, thankful that we'd found a place to land.

The easy trip from Vancouver to Prince George on the way up became a nightmare on the return, and heaven help us if we hadn't been over the course once so we knew where the emergency fields were. (The map didn't indicate any airports.) At one point we found ourselves deep in a small river canyon, clouds hovering half-way down the mountains that loomed on either side of us. If the plane had not been small and slow, we never could have made the curves of that canyon without scraping wings on the edge. When our stream finally entered the Fraser river, we breathed a sigh of relief.

We were so much relieved that we laughed even when rain showered down and the ceiling came lower and lower, till our plane was 400 feet above the water and even then cloud-scud occasionally floated beneath us. We knew where we were anyhow, there was a black-top road running alongside the river that we figured we could land on, and we knew that Hope's emergency landing field was due to come up soon. We gratefully fluttered into it, you can bet.

An hour's wait and a call to Vancouver convinced us that we'd gone through the worst and could proceed. We bounced on the runways of Boeing field in Seattle at sundown—20 days after we'd left.

END

Train Their Customers

THE Lockheed and Vega Aircraft Corporations have established a special customer service organization for the training of flight and service personnel of the U. S. and allied air forces. Pilots and mechanics from various units of the U. S. Army Air Forces, RAF and RAAF are receiving first hand instruction in the operation and maintenance of *Hudson* and *Ventura* bombers and *Lightning* P-38 interceptors.

Graphic Calculus

(*Continued from page 66*)

The procedure of finding the slope of the tangents drawn to a curve is too lengthy. Many instruments, some of them mechanical marvels are used for plotting the slope curve. For students, however, a simple device shown in Section 5 will greatly help them to comprehend the working of differential calculus. A piece of celluloid 4 by 5 inches in dimensions 1/16 inch thick has the tangent line engraved parallel to one edge. A vertical line to the tangent line is the zero line for the graduations.

To graduate the instrument a line is drawn on a paper parallel to the tangent line at a unit distance on which decimal distances are marked. Connecting the marks with the center point of the instrument the graduations are engraved on the reverse side with a fine needle point. The graduations should not go beyond 2.0. Therefore the scales for the diagrams should be selected so as to give slopes no higher than 2.0.

If celluloid is not available a regular triangle could be engraved as illustrated in Section 6.

The method of reading slopes with the instrument is shown in Section 7. Any vertical line of the diagram may be used as long as it passes through the center line of the instrument and the tangent line is on the point of the curve to be differentiated.

Plotting slopes with the instrument is simple except that the multiplication factor must be first determined by taking the slopes of two even values. For example if the slope for 10 feet and one second is .5 then all slope reading must be multiplied by 10/.5 or by 20 to give the correct feet per second or velocity plotting. In Section 8 a curve is plotted for two variables. Tangents are noted on various points and plotted on the lower diagram.

Interesting results are obtained by differentiating the flight curve of an airplane plotted for height and time as shown in Section 9. Differentiating the upper curve, the climbing or diving speed of the airplane is plotted in the middle diagram. Differentiating the second curve we obtain a curve giving the feet per second or the acceleration of the plane. The acceleration of a free falling body is 32.16 ft/sec/sec, also denoted as g. If the negative acceleration of the plane is greater than g the pilot will be thrown from his seat against his belt, as marked on the lower curve.

For practice, the differentiation of the space-time curve of a free falling body should be used. In the upper diagram in Section 10 the distance and time of a free falling body is plotted. The first differentiation will give us the space divided by time or the velocity per second as plotted in the middle diagram. It should be a straight line. The second differentiation will give the rate of change of speed or acceleration. This should be 32.16 ft/sec/sec, a horizontal line.

Graphic differentiation of space-time is used in evaluating tests conducted on

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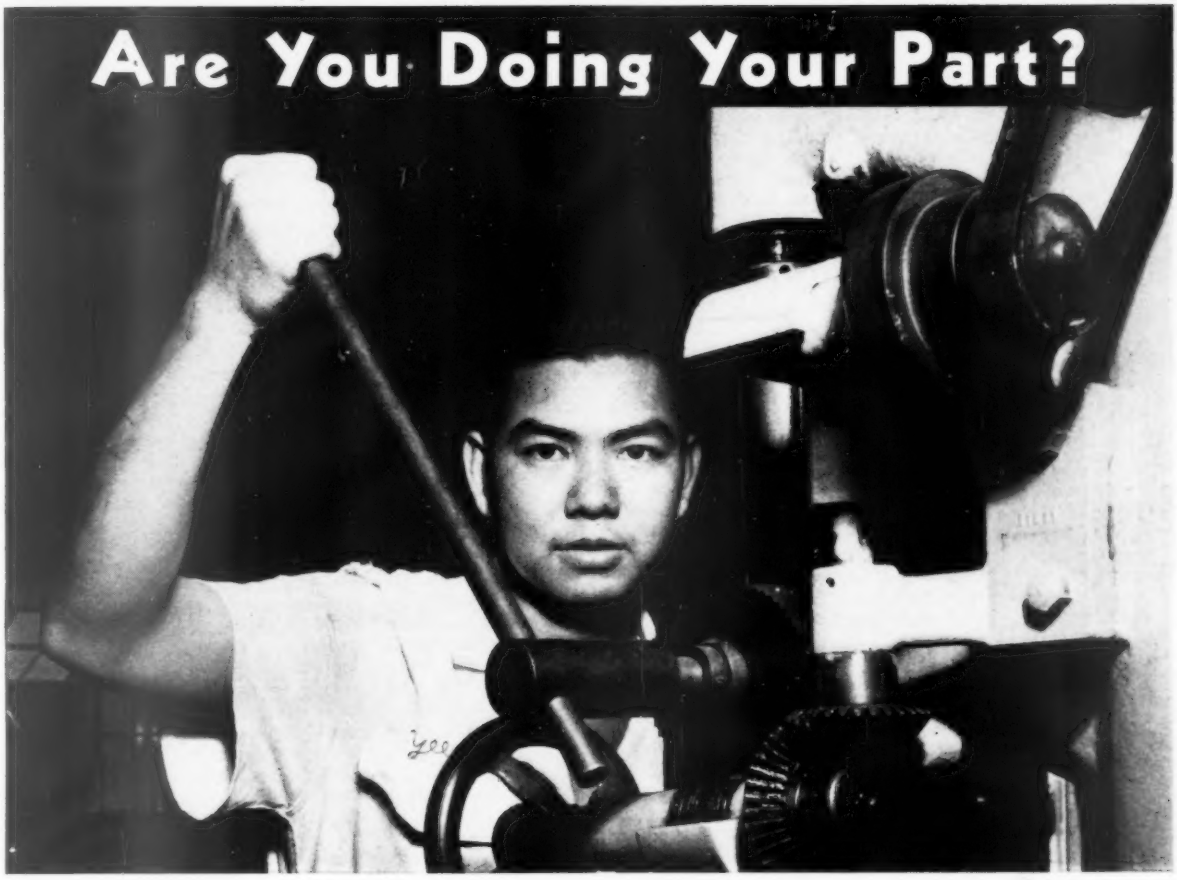

"If we will all work twice as hard . . .
we will win in half the time."

These are the words of Bart-Lum Yee of Tallulah, Louisiana. He is a self-educated young American of Chinese descent who feels deeply about the war because many of his relatives and friends have been in China fighting the Japs for the past five years. He is studying aircraft mechanics and plans to study flying at the Dallas Aviation School until he is called to active service. His greatest desire is to fly a bomber over Tokio.

"Although we did not start this war, we are going to finish it. But, in order to win, we must all ask ourselves this question: 'Am I doing the best I can?'"

Every man and woman in the United States is needed to help win this war. Are you doing your part?

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landing gear shock struts in order to find the maximum absorbed and dissipated energy in terms of the free drop height. Also to find the load factor in g's. The tests will also show the best inflation pressure to use in the wheels.

In the testing machine the wheel, wheel frame, shock strut and weight box moves freely vertically. An arm attached to the weight box operates a revolving drum that carries recording paper. Another arm is attached to the wheel frame that operates a second revolving drum with recording paper, a timed synchronous motor records the elapsed time in fractional seconds on the drums. The whole unit is dropped from a certain height. The space-time recorded on the drums are then used to plot the diagrams to be differentiated. A practical example in Section 11 demonstrates the sequences of differentiating the test results.

In the diagram the space-time curve is plotted from the recorded drop test. Reading the slopes and multiplying them with the factor noted on the diagram, the velocity curve is developed in the second diagram. Differentiating this diagram, the acceleration curve is obtained in the lower diagram. For simplicity the diagrams are shown in upright position instead of in an inverted one. For finding the absorbed and dissipated energy of the shock strut a diagram is constructed using the travel from the first diagram and the acceleration from the third diagram. It is shown in the bottom of Section 11, which also gives the maximum load factor the shock strut will attain.

Another interesting application of the space-time curve is to be met in designing cams for oscillating units of equal accelerations and decelerations. To eliminate the cut-and-try method the sequences of graphic differentions are reversed, as illustrated in Section 12. The start is made from the acceleration diagram which has horizontal positive and negative lines. Then the middle diagram is plotted for the velocity diagram. This will have only straight lines as shown. From this the upper space-time diagram is plotted to give the layout of a cam giving equal pressure on the cam follower. The consecutive diagrams are drawn by taking the slopes of the preceding diagram, placing the instrument at the proper slope and by drawing a line at the free edge. The more points that are selected the more exact the cam will be. To time is usually represented by the angular displacement of the cam in degrees. For checking, the operations should be reversed.

Graphic differentiation is a great aid for investigating many engineering problems that deal with changing velocities. Such problems include looping, take-offs, landing runs and maneuvering. They may aid in finding forces of oscillating masses or investigating wing sections. Differentiation also is used in statistical matter.

END

The Fallacy of Dispersion

(*Continued from page 43*)

8,000 people were killed in Cologne, while neutral sources say the number was 25,000. Aerial photographs show that the central part of the city was wiped out, that entire factories were reduced to rubble. Cologne, as a going war concern, is gone.

This raid, and other large-scale raids made since then, made obsolete all previous estimates of the destructive power of the bomber based on experiences of 1940 and 1941. The stepping up of range and load, as well as the number of planes engaged during the summer and fall of 1942, mark a turning point in the course of air warfare.

In a two-month period during 1940, the RAF dropped 3,500 tons of bombs on Germany and occupied countries; during the same period in 1941, 8,500 tons were dropped; in June and July this year the amount had increased to 13,000 tons. It was dropped at an average cost in losses of less than four per cent of the machines and crews engaged. However, this low rate of loss is due in large measure to the fact that more than half of the German fighter strength is engaged on the Russian front. A German victory in Russia would release a large part of this force, or what is left of it after the Russians have whittled it down, to defend Germany and to undertake raids on Britain. Thus the present RAF preponderance in the air over Germany may not be a permanent condition. If this winter the Germans are able to return to the western front with most of their air force, including the new heavy bombers which are known to be in production, the British and ourselves may find that we are on the air defensive in England. While we may still stage the bombing offensive, we will face heavy German counter-raids; the air war may become one of attrition, with blow matched by blow.

In his excellent book, "The Coming Battle of Germany," (which should be required reading for Congress) William B. Ziff quotes an informed British leader who said to him: "If we don't blow Germany out of the air the Huns will finally blow England out of the air, and will win the war by literally blowing away our industries and communications until there is nothing left." It should be noted that there is much less to blow away in England than there is in Germany, and that it is a conveniently concentrated target, while Germany is a widely dispersed one. The race for air mastery is already under way in the factories and in the training schools, as well as in the air over Europe. Whoever masters the air will be master of all that lies beneath.

"Only in the coming battle of Germany can we settle accounts once and for all with the Axis," says Ziff. "If the Nazi citadel were knocked out, Japan would be left in a hopeless situation." He advocates a reasonable diversion of our raw materials and industrial energies from other and less needed equipment to enable us to boost the monthly output of four-engined bombers from the present estimated 500 to several thousand a month. "If we were to concentrate on the output of heavy bombers on the largest scale of which our industrial capacity was capable, for a shattering assault on German communications, industry and morale while the Reich is still inextricably engaged in the East, we could certainly well hope that the effect would be decisive. We should not wait but should begin now, throwing into the breach everything we have."

This is bold thinking, and as logical as it is bold. It cuts to the heart of our present predicament—dispersion in every field of military effort, land, sea, air and geography. In the air, using England as our outlying airport, an unsinkable aircraft carrier anchored right beside Europe, we could achieve concentration of force to be applied directly to the heart of the Reich. "Bombing, without plan and without continuity," says Ziff, "cannot produce the results desired. Only a continuous scheme of destruction based on a systematic reduction of communication centers, viaducts and bridges, shipyards, key factories, oil reservoirs and industrial aggregates, can defeat the enemy by making it impossible for him to carry on. Our ultimate goal as the grand finale of the great operation should be a continuously replenished pool of 5,000 heavy bombers weighing up to 300 tons each, with speeds in excess of 400 miles per hour. Whether or not we reach this goal is not as important as that we drive rigorously toward it. Five thousand Consolidated B-24's or Boeing B-17 E's would serve our purpose nicely and would do a first class job in reducing Germany to a pulp."

Germany, of course, undoubtedly is thinking that such a force of German bombers would do an equally first class job of reducing England to a pulp. Heavy RAF raids of the past summer have achieved not only immense destruction; they have made the Germans the most air-conscious people in the world. The most effective way quickly to make anyone airminded is to drop a large bomb near him. The English people, for example, were sold on airpower, not by the British Air Ministry, but by Hitler's Luftwaffe.

One of the reasons why we have not concentrated American airpower in England for an all-out assault on the Reich is because our people have not had a visual demonstration of the effectiveness of bombing. There is no public clamor for an American air offensive, nor even much editorial support for it in the press. In the air war against Germany, as in the land war, we still are bystanders. Our people, a comparatively tiny percentage of them, read such books as Ziff's, or Seversky's "Victory Through Air Power," and on the whole may agree with the reasoning contained in them. But they raise no outcry to Congress, demanding to know why, after more than nine months of war, our airmen have not dropped a single bomb on Germany. (The few tons so far dropped on

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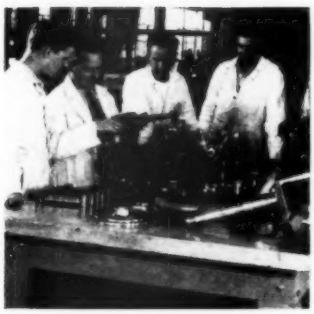

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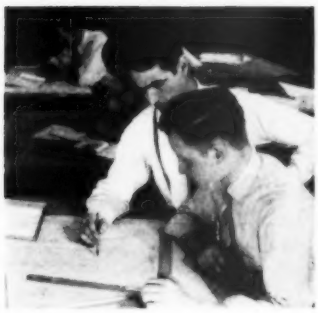

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unfortunate occupied countries by our *Flying Fortresses* made bigger dents in the headlines than they did in the German war machine.) If we had one good bombing of Washington, especially if it was precision bombing on the buildings housing our General Staff and Naval High Command, we might be jarred out of our complacency and give immediate and serious attention to the creation of a real second front in the air over Europe. We might, at last, concentrate, instead of dispersing our war force.

If we can learn anything from our enemies, we should know that the Germans and the Japanese have won all of their victories by concentrating on one objective at a time. Hitler met his first reverse on land only when he dispersed his forces over a 2,000-mile front and tried to lick all Russia at one fell swoop. If last summer he had not considered everything from Leningrad to the Caucasus to be vital points, but had concentrated his forces on the Caucasus, he might and probably would have chopped off that 80 per cent of Russian oil in 1941, and thus have started to immobilize the whole Red Army. Instead, he spread out, attacked everywhere, failed, and had to start all over again this year with forces greatly weakened by his ill-advised dispersion. History may well set down his eventual failure to the fact that he dispersed his forces so widely in the 1941 attack on Russia.

However, it seems doubtful that we have learned anything from Hitler's failure, for the President said in his speech of September 7: "This war will require vast assemblies of weapons and men at *all the vital points of attack.*"

The italics are mine. They underline our obvious strategy: trying to send vast assemblies of weapons and men all over the world. Like the Irishman, we're going off in all directions. Chief difference: it's going to cost us more.

If right now we start to concentrate American airpower in England and combine it with British airpower to smash the German war machine at its source in Germany, we will have taken the right step to achieve a concentration of force to deliver blows where our most powerful enemy is the most vulnerable to attack. And that is right at home.

END

From Headquarters

(*Continued from page* 46)

—August 14 to September 14, 1942—when the ratio of enemy planes destroyed to U.S. losses in combat was 7.5 to 1.0, and you have the normal all-American pace when morale is good, irrespective of planes!

We have plenty of shortcomings, but those who harp on the quality of our planes are off the track. It would not matter much how people squealed about our real problems, but to bring up the subject of equipment, especially when it smothers the morale of the pilots out there alone on the front, is wicked.

* * *

Maj. Clifford Harmon, nephew of Clifford B. Harmon, (first man to fly a Farman over Long Island Sound and later the organizer of the *Ligue Internationale des Aviateurs*) has just returned from an assignment "down under." Naturally, he had many good tales, but one struck me as particularly interesting. An Army captain, a friend of his, embarked for a similar assignment. En route his boat put in at a certain city—the officer went ashore—and there met a friend, captain of another steamer, en route to the same destination. The Army man went back, got his kit, and changed over to the other ship. The first ship was torpedoed and all were lost. His wife back home was officially notified of her husband's fate. She had just cashed the insurance check and was starting to make a go of it alone in life, when along came a letter from the husband, alive, happy and well. He had gone through on the second boat safely.

* * *

Congratulations are surely in order to General George again! This time, for his selection of Mrs. Nancy Love as director of the women pilots' division of his Command. Those of us who have known Nancy at air races and elsewhere rejoice in this selection and know that her appointment will be in the very best interests of the service.

* * *

The Bearded Bard of Biscarosse, Sedley Peck, who flew with the French until instruction Squadron 35 got him in World War I, is back in the game. He went through the 1940 blitz in France as director of the American Volunteer Ambulance Corps and is now out in the camps—has lectured in 115 of them all over the country, and to audiences as large as a whole division at a time—telling just what happened in France. Sedley says that on June 4, 1940, the Germans had 4,000 planes of all categories on the lines, while France had just 244 ships left which were fit to fight. Eighty thousand civilians on the crowded roads of France were killed by the bombs and guns of the Hun flyers during the four weeks between Sedan and the capture of Paris. Sedley tells a lot about the overrated Stukas and the outdated transport ships which the Germans used to bomb unfortified places after they owned the sky.

* * *

Peculiar situations developed in this war. One of the aces of the last war came to visit last week. In the years between, he has been most successful in business but was one of the first to join up for this show. He enjoys a comparatively low rank and when I inquired of his come-down in pay from that in business, he replied, "Oh, that part is all right—in fact my Army pay is much lower than I got in the last war 20 years ago."

* * *

We have not seen anything in the newspapers on something which struck me forcibly. A pat on the back is relished even by an airplane factory, so here goes:—I repeat what Brig. Gen. Arthur W. Vanaman said on the opening of the Indiana plant of Republic Aviation Corp., which turned out its first P-47—from grass-roots to first hop—in five months, "It (the P-47) can outfly and outfight any other type of plane in the world." Good work, Republic!

* * *

This writer seems to be the only one who writes about funerals. But when a real flying pioneer passes on one cannot help paying him that tribute. Col. William Ocker, "Old Bill," as we all called him, accredited with being the instigator of blind flying and a real soldier who arose from being Billy Mitchell's right-hand enlisted man to a full colonelcy in the Air Forces, turned in his log book at Walter Reed Hospital here the other day. The night before he died, a friend of mine went over to see him, carrying messages from General Arnold and other high ranking officers. Ocker's face seemed to light up especially when my friend stressed the role of instrument flight today and told of the general recognition given to Ocker. Bill's patent applications had worried him for years and the postponement of the official award and recognition until this autumn undoubtedly preyed on his mind and provoked his affliction.

It is only a few months since the first flight indicator which he fashioned and fixed to a DH4 strut got him into trouble. His commanding officer ordered the indicator taped over and Ocker stood a court martial indirectly preferred because of his pioneering ambitions.

* * *

Impressions on the war—shot comments—may well be in order especially coming from Washington, snatched from the merry-go-round.

Germany knows she will never win this war until she has invaded England. Her next move will be just that. She is constructing literally hundreds of airports in occupied France for that purpose. Transport gliders towed by planes with liquid cooled engines will be used. (If Herman and Adolph's plans work out as anticipated). The Luftwaffe will gamble in that they will attempt this invasion without the orthodox aerial supremacy of the air over England. She will gamble on a come-back from Russia and move 80 percent of the Luftwaffe to channel and near-channel fields. Her first objective will be American and British airports on the British Islands. Germany has not forgotten the "duck-soup" tactics in Poland when she gained complete aerial supremacy first and then flew anything with wings on it (and no guns) to help clean up airplane factories and airports. She thinks she will effect surprise but she surely has another think coming and, although she will have plenty of pilots, most of them will be the 20-hour glider pilots flying dive bombers. (Lately, Germany's Stuka pilots have had but 20 hours flying time on gliders before going over, on the theory, "What's the use of more?" Such pilots use no instruments and they go over once only anyway—pilots are expendable.)

(*Continued on page* 122)

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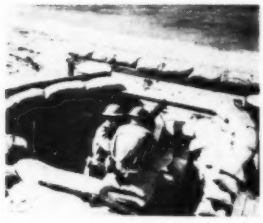

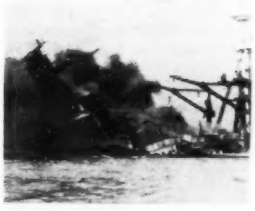

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Did you ever hear about the mascot—a little doggie in one of our fighter squadrons? His name is "P-40."

* * *

Did you notice the War Department announcement stating that *Flying Fortresses* used in training combat crews at Hendricks Field, Sebring, Fla., had landed no less than 32,219 times with only eight minor accidents?

* * *

Have you taken time lately to look over national weekly publications of but two years ago? My, how the isolationists and appeasers must blush and wish they had kept their mouths shut! All these theorists, who through many tragic years of peace forestalled international cooperation and brought on this war and the loss of our loved ones, have still a chance to be real sports—let them enlist for front line service!

* * *

Now that Glenn Martin has stated that there is no technical limit to the size of airplanes, why not consider the whole globe as just a place to fly, keep on preparing airports as already started, use lakes and the sea and go to it in the great ocean of the air.

Expanding on this thought, possibly the Navy should literally take to the air and, if the *Lancaster* land-based type aircraft has made battleships and aircraft carriers *passe*, let the Naval organization be the independent air force dream of Billy Mitchell, with surface vessels subsidiary as they already have been in this war. Then aviation would have a place of rank equal to the Army and we could obtain unity of command,—the prerequisite to victory in this war.

END

Fighter Pilot

(*Continued from page* 28)

speed drops below 175, he lowers and locks the wheels, double-checking the latter by pumping the control handle. He closes the cowl flaps and drops the wing flaps, keeping the air speed at 120 m.p.h. He breaks the glide with a neat level-off and then holds the plane just above the surface of the cloud until the waning speed settles it in a soft three-point landing—figuratively, of course, for he is still 7,000 feet in the air. What really happens is he holds the plane off until it stalls, then dives to regain speed and climbs on up for another approach, retracting the landing gear as he takes on altitude.

By the time he has made five or six cloud landings, the instructor is at the radio microphone in the control tower prepared to call out corrections during the next step of this lesson. That consists of real landings on the airport. The trainee glides on down and gets into the traffic pattern at 2,000 feet. As he swings into the base leg of his approach at 180 m.p.h., the instructor's voice pours into the headset:

"Tighten up on that turn. Now back off on that throttle and lower the wheels. Lower your wing flaps. Not so much; 30 per cent is plenty. Keep that nose down. Let her come in fast. Don't level off so high. What do you think you are doing—landing on another cloud? Hey, go on around again!"

The trainee opens the throttle and climbs on up to 2,000 feet for another attempt. This time he gets down in a manner that satisfies the instructor.

Lesson Two consists of a series of engineering flights in which the trainee is told he is playing the role of test pilot. Instructors have found that this title buoys the trainee's confidence and cuts hours from this phase of the course.

In engineering flight No. 1, the trainee is sent up to 6,000 feet to do gentle and steep banks and to compare the forces on the three controls. From there he goes to power stalls in which he pulls the ship up into an almost vertical climb, until it stalls for lack of power. At that instant just before it stalls, he watches for telltale vibrations and sounds that may serve as warnings in his future flights in this type of aircraft. As the nose falls to regain speed, he watches for any tendency to go into a spin.

The second engineering flight starts with an open-throttle climb to 10,000 feet with the altimeter reeling off 1,000 feet every 10 seconds. It then directs the trainee to level off and put the ship through speed runs at full power.

The official report asks the simple question:

"How did it feel?"

Most trainees answer with the one word:

"Swell!"

The last engineering flight is a high altitude mission with oxygen. Climb to 25,000 feet and make full-throttle speed runs. The pilot is warned to turn on his oxygen at 12,000 feet.

On the way down he practices steep dives, remembering the casual tip in the instruction pamphlet: P-36 requires about 8,000 feet to recover from a vertical dive!

The decision hinges on the trainee's progress, but at this point they usually transfer to the P-40, starting off with lesson one, the blindfold test, and following through the engineering flights.

Assuming the trainee is at home now in the P-40, the next lesson is acrobatics, the fine art of dogfighting. Up to the minute maneuvers flashed from the war theaters are taught. By means of models and blackboard diagrams, the instructor explains the maneuvers and how they are performed with a P-40—how to get into and out of them, how much throttle to use and so on.

"Get plenty of altitude," is the final warning before the trainee takes off.

The instructor follows in a second ship, from which he radios helpful advice as the trainee ties the P-40 in knots.

Hand in hand with the dogfighting goes ground and air instruction in the operation of the newest aircraft machine guns and cannon. The trainee devotes 46 hours to this subject and when grad-

The vital importance of precision in every maneuver is impressed on the fighter pilot. Here a camouflaged Army Curtiss P-36A is executing a perfect 90° vertical.

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Aircraft Spotters' Guide—No. 3

uation day arrives he is an expert marksman. Skeet shooting is a favorite way of developing this marksmanship.

Next comes formation flying, the concentration of firepower which is the basis of air warfare. The trainee had some of it in his cadet days, but this will be at twice the speed.

His first taste with a P-40 is in a Vee-element of three planes in which the other two pilots are veterans. By means of hand signals they direct him into position and take him through easy turns. As he learns to fly one of the trailing positions of the Vee, he is switched to the other side. Finally, he goes into the commanding lead position. From flying in a single element, he is advanced to a six-ship flight, and finally to a nine-ship flight.

Cross country practice and observation are next. The instructor outlines the lesson thus:

"While you are flying cross country I want you to keep your eyes open wider than ever, just as if you were over enemy country. Observe and identify everything you see on the ground or in the air. When you get back I want you to make a list of all the things you observed. I am going to make a list, too, so your's better be complete."

These cross country flights, in which the instructor trails in a second plane, lead right into ground lessons on identifying friendly and enemy aircraft. For these lessons, models and silhouettes of allied as well as German, Italian and Japanese planes are moved across a screen until the trainee is able to identify them from any angle. Considering the speed of the modern fighter craft and the fleeting glimpse the pilot gets, it is most important that he be able to tell instantly to which side a sighted plane belongs, his or the enemy.

He starts night flying lessons with his old friend, the AT-6, dual control cadet trainer, so the instructor can learn if there are any bad night habits to overcome. Next the P-36 and then the P-40. Gradually the trainee is worked into night formation.

For his final test in the entire course, he is pitted against an experienced fighter pilot in a dogfight. However, unlike war combats, these foes discuss the battle before and after fighting it, and use camera guns. After they have decided upon the zone in which they will meet and from what angle and the altitude, the trainee and his foe take off and climb to 10,000 feet. Then they fly at each other until they are within gun range, pull up in a steep climb and the battle is on.

The trainee climbs in an effort to get the upper hand for a first maneuver that may win the battle. Uppermost in his mind are the famous "Don'ts for Aerial Combat":

DON'T needlessly sacrifice altitude.

DON'T rush in without thinking how you are going to attack. On the other hand . . .

DON'T hang about trying to work out something very clever, as there probably is another enemy plane very close.

DON'T forget to take advantage of the sun and clouds.

DON'T open fire too soon.

DON'T fire longer than three seconds without looking around.

DON'T hang around when all your ammunition is gone.

DON'T get excited when the enemy is sighted.

DON'T open your hood until the last moment if on fire and bailing out.

DON'T follow a machine you have shot down; there may be a kick still left in the air gunner or he may have a pal just behind you.

DON'T go into combat without goggles over your eyes. Splintered glass is not good for them.

DON'T go off without your goggles, gloves and flying boots. They are a great help in case of fire in the cockpit.

DON'T wind your oxygen tube around your neck. It may choke you if you have to bail out.

DON'T *get shot down!*

With that instantaneous reaction to attack, the long patient hours are rewarded and now our trainee is no longer a fledgling, but a cool, calculating fighter pilot. Ten minutes later he makes a jaunty three-point landing and hands over the camera gun to the instructor. A Jap or German is next.

END

THE LIBRARY

GAS WARFARE

By Col. Alden H. Waitt, New York; Duell, Sloan & Pearce, 1942. 315 pages; illustrated; index; $2.50.

Of particular interest to the layman is the author's comprehensive description not only of all types of chemicals used in war but a meticulously outlined measure of protection against each of them. There has as yet been no widespread use of gas in the present war. This, perhaps, is due to the certainty that each side has at its immediate disposal everything that the enemy might put forth. Therefore, an opening of gas warfare by one side would be stalemated by identical retaliatory action. However, it would undoubtedly be the civilian who would suffer, as is the case in indiscriminate air bombing of cities and towns.

For this reason, if for no other, Colonel Waitt has done a valuable service in making available to the general public his complete and easily read book, in which his long experience as a member of the Chemical Warfare Service enables him to write with such complete knowledge and authority.

For the military reader, "Gas Warfare" will prove an invaluable instructive manual, as the author stresses the tactics of chemical warfare, showing why gas can be used in one situation and not in another. Technicians will be deeply interested in Colonel Waitt's explanation of how chemical warfare is not merely a question of expending gas shells or bombs or spray, but a complicated matter involving winds, temperature, humidity, terrain growth and the intent of the attack.

ENGINE TROUBLE CHART; arranged by Andrew Wallace, crew chief, Eastern Air Lines, Inc. Norman W. Henley Publishing Co., New York, 1942. Price 75 cents.

A reference chart arranged so that a novice (or trained mechanic) may quickly learn to identify and correct engine troubles. Expertly prepared, the chart's main headings cover noise or symptoms, probable trouble, probable cause and remedy.

Water Runways

KEEPING U. S. aviation always one step ahead of the enemy is the objective of the Civil Aeronautics Administration's technical development division. Under the impetus of war needs, its projects have been speeded up and expanded.

There is, for example, the seadrome day marker, importance of which has been brought forcibly to the attention of civil and military authorities by accidents to flying boats in tropical seas. A product of the airport development section of the division, these markers have been ordered in quantity for immediate use even before service tests were completed.

The markers are floated on a rubber "doughnut" similar to those used for seadrome night markers, and they carry distinctive symbols on standards six to nine feet above the water. These symbols, one a circle and the other a triangle, give the pilot a silhouette from all angles. The "doughnuts" are anchored in such a way that the wind and tide do not tilt them very far from the vertical.

15 YEARS AGO

FROM the December, 1927, issue of this magazine:

The feature article "When Ford Went Up" recorded the historic "first flight" of both Henry and Edsel Ford when, piloted by Col. Lindbergh in his "Spirit of St. Louis", they flew for the first time.

The attempted transatlantic flight of the *American Girl*, a Stinson *Detroiter*, came to an end when Ruth Elder and George Haldeman, their gasoline almost exhausted after battling bad weather and head winds, landed their plane in the ocean near a Dutch tanker and were rescued.

Details of the Daniel Guggenheim Safe Aircraft Competition were made public. First prize was set at $100,000 with the first five manufacturers to qualify and successfully pass the tests receiving special $10,000 awards.

Wright Field, Dayton, O., was dedicated (October 12, 1927) to the use of the Government.

Editorial: " . . . the time . . . will come when the rapidly increasing traffic must be confined to certain levels . . . probably future legislation will provide . . . a certain fixed level for travel in one direction and another level for travel in the opposite direction . . . " (Note: it did.)

Advertisement: "Curtiss OX-5 propellers, copper tipped and in original boxes, $3 each."

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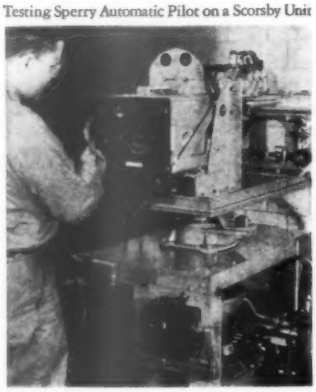

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Airports

(*Continued from page 40*)

to overshadow evaluation of future possibilities.

What are the prime factors to be considered in the selection of an airport site? Briefly, the three principal categories into which questions and answers fall are: (1) aeronautical, (2) engineering, and (3) economic.

If you are confronted with the problem of selecting a site, what answers do you formulate for the following questions, three in each group as noted?

Aeronautical: (a) Is area available for a sufficient number of landing strips of adequate length providing coverage of wind conditions for the type of operation proposed? ("Sufficient" and "adequate" do not mean "minimum"!); (b) Are approaches and turning zones relatively free of obstructions, natural or man-made? If not, can the obstructions be removed or can *safe* operation be conducted by establishing certain minimums or restrictions? (There can be no compromise with safety!); (c) Are other airports or congested airspace near enough to constitute hazardous operating conditions, either through conflict of traffic patterns, let-down procedures, or confusion to itinerants? (Airports should be separated by six or more miles except under special conditions requiring thorough study.)

Engineering: (a) Are there drainage problems? (A site which appears to be fine in August may be a veritable bog in November or March); (b) Are there grading problems? (If excavation is required, beware of uncovering inferior material or unexpected rock); (c) Can power, water, phone and sanitary facilities be readily installed? (It is best to have definite arrangements with utility representatives and an understanding with local sanitary engineers prior to acquiring any site.)

Economic: (a) Is the airport so situated that it will serve the greatest number of people with a minimum of surface travel, but at the same time is it so situated that it is capable of being expanded and extended in the future to coincide with aeronautical and engineering demands? (A site located on a paved highway equidistant between two towns or cities of comparable size is ideal); (b) Is it believed that revenue from the airport will pay operating and maintenance expenses and write off capital investment costs, or will contributions, assessments, allocations, or budget allotments from some source be required? (Figure this out *first*, then plot your course accordingly); (c) Even though it is believed that you have a satisfactory answer for the above question, if there are other airports in the same trade area which are reasonably well located, have you explored the possibility of consolidation or merger of activity and interests as a more desirable solution? (While many communities can readily justify the existence of several airports, others would be in a better economic and aeronautical position with unified effort and centralized control.)

If you have legitimate affirmative answers for all of the questions, the odds are that you have a suitable site. The same may apply if you have sound answers for eight or even seven. If you can answer but six or fewer, you either don't have much of a site or you have a special problem requiring analysis by experts.

A recitation of "book" rules is deliberately omitted from this dissertation for several reasons. *First*, we seldom encounter the ideal site at which *all* of the established rules and regulations are satisfied prior to development or expansion. *Second*, the rules and regulations become more inflexible and advance in number as an airport assumes more importance and the number and type of aircraft movements increase. *Third*, any rules in a rapidly expanding industry must necessarily be altered from time to time just as changes in the application of rules must occur because of differences in geographic location, elevation, temperature and climate.

As examples, let us take the CAA recommendations for minimum glide angles within approach zones to landing strips and runways. The glide angle for small, private flyers' fields in such zones should be not less than 20 to 1. That is, obstructions may not exceed five feet in height for each horizontal 100 feet in distance from the *edge* of the *usable* landing area. Larger airports, however, should have glide angles of 30- to 40-1, depending upon the adequacy of runways and the type of operation. Available landing area lengths are not, therefore, measured from fence to fence, but from points 80 to 300 or more feet inside the fence depending upon fence and other obstruction heights.

Probably the most common defense of the selection of a poor site is the statement that the better sites are too expensive. It is true that good airport sites are usually at locations which have value for agricultural, residential or industrial purposes. But *too* expensive? Well, that's open to argument. The same reasons which make expensive sites valuable for other uses will often make them valuable for airports. Remember that cheap sites are frequently like cheap suits—one has to be careful with either, especially in the rain! Bear in mind that good sites are like good suits; both wear well, and when their occupants become paunchy with prosperity there is enough material to permit a little "letting out" here and there.

It is almost sacrilegious to mention this point, but it has happened. A well located site may have considerable resale value as a subdivision, golf course or as improved agricultural land if the airport doesn't continue to justify its existence.

Certain sections of the United States are not blessed with many potentially good sites. In fact, some areas are confronted with serious engineering and economic issues in the consideration of an aeronautically sound development for even the smallest class of airport. Terrain does impose limitations on development and does restrict operations at certain points in every state. Generally speaking, however, there is a reasonable solution in each specific case. A reasonable solution is not reached without considerable study and effort on the part of local enthusiasts, particularly when cooperation from other agencies is expected.

If you plan much of an immediate investment on your initial acreage, investigate fully all angles of protecting that investment by acquiring adjacent land, by obtaining long term options, and by securing establishment of zoning ordinances and laws if none exist. Although the funds for the original development may be small and the prospects not bright, protect whatever you do by anticipating growth. Unless you are a private owner scratching out a small field for your exclusive use, any site which is developed with the thought of group operation must be given serious considera-

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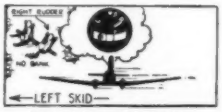

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tion. You may not have a possible transport field; you may not want such a field. But you will want a field to accommodate the tremendous increases in private flying alone. You'll need more hangar space, more auto parking area, slightly larger landing area lengths, paved runways—possibly parallel runways—lighting and many more items. The planning of an individual airport is a separate problem, however, peculiar to that site, and if the basic principles of selection set forth herein have been observed, planning becomes but a matter of application of recommendations, rules and regulations to details.

Those principles again? Here's the easy version:

No compromise with safety. (Aeronautical.)

Land cost may be least cost. (Engineering.)

All pastures aren't airports. (Economic.)

END

Next Stop: Tokyo

(*Continued from page 40*)

They learn to guard their watches with their lives, for the accuracy of their work hangs on these timepieces. Each day they "hack" (correct) them with the station master watch and on all missions synchronize them with all others on board. All watches are set Greenwich Civil Time.

Their ground and air classroom work is spread over a five-day week, starting at eight in the morning and continuing to as late as 10:30 at night. Sometimes, when they are learning the celestial guides, they are called out at midnight to study a particular star. Saturdays they have military drill and Sundays they rest—if they haven't any flights to make up.

Three serious navigational errors—and the cadet is out. Another cause for dismissal is tendency toward air sickness as the navigator must remain 100 per cent efficient in the most violent storm, if he is to save his plane and crew. Of all the members of a multi-motored plane crew, the navigator is the one most liable to get airsick, for he does considerable of his work with his head down, poring over columns of fine-print tables.

Upon graduation they are commissioned second lieutenants in the Army Air Forces, given silver wings with an "O" in the center and rated as technical observers. A special wing for navigators is reported in the process of designing.

The majority of the graduates is assigned to duty with combat organizations. A certain portion remains at the school to aid in instructing the next class. A number of recent graduates from Mather have gone to the Ferry Command for an extra month of cross-country experience, but when they leave any of the Army navigation schools they are qualified to navigate a plane to any point and back, under any conditions, no matter how long and difficult the flight.

Now let's go on a final test—a flight to Tokyo. It is a simulated mission, as far as reaching the coveted objective is concerned, but all hands carry it out with the enthusiasm and technical detail of one actually under way to flatten the Japanese capital.

Long before they finish the 15-week course, any student-navigator can rattle off the Great Circle courses to follow and the distance—4,508 miles from Sacramento. "Change course 12 times; come within 100 miles of the Aleutian Islands on the top of the swing."

Our plane is a twin-motored Beechcraft monoplane advanced trainer officially known as the AT-7. It was especially designed for navigation training and the cabin is fitted with three desks, each equipped with the latest navigation instruments and devices. On instruction missions the plane carries two students and an instructor, or three students with each taking turns at the role of first navigator.

In the roof of the cabin is a calibrated turret through which celestial observation are made. On one wall are duplicates of the pilot's flight instruments. On the other is a duplicate of the pilot's radio compass, a device for "homing" on radio stations. In the floor is a trap door for releasing flares. Clamped to the wall opposite the desks are oxygen tanks for high altitude. The outlets and face masks are hanging from pegs above the desks. At each crew station is inter-communication and radio equipment.

First to come aboard are two navigators taking their final test. Then the two pilots, recent graduates of the Army's pilot training program. The four had just come from a "briefing room" where they had received the latest weather reports for the projected mission.

In a flash we are on our way at 140 m.p.h., climbing at 1,500 feet a minute. Already the navigators are busy working out their courses, taking free-air temperature and other readings to correct the many recording instruments. Each is working independently of the other and there is no "cribbing."

One starts swinging a compass at his side by some mysterious routine he performs with a drift indicator, a strange looking device with a rubber eyepiece.

As soon as they have checked their instruments, each navigator takes a "double drift," recording the rate of drift by sighting through the eyepiece as the pilot obligingly flies the plane on one heading and then another. For one sight a long fence is used. For another, a stretch of highway which is known to be absolutely straight.

Then one twirls away at the dials of the radio compass. He selects a signal and centers the "homing" needle on his and the pilot's sets. As long as the pilot keeps that needle centered we are "on course"—that is, that portion of the course for which radio navigation is to be used. It must be some distant commercial station because we have left the airways and are striking out on our own.

At 10,000 feet we level off and the speed steps up to 180 m.p.h. The navigators make a record of the altitude and increase in speed, correct the figures with the free-air temperature, make another check of the drift, then go on checking and cross-checking the position of the plane with the four methods of navigation.

Every few minutes one of the navigators hands the chief pilot a message which gives him the exact position of the plane, where it will be so many minutes hence and any changes in course. This note is condensed from a maze of mathematics which almost covers their desks. It is in this work they use those needle-pointed pencils.

The accuracy of their navigation is amazing to a sky warrior of World War I who learned to depend upon the shiniest railroad tracks to guide him from one point to another. The wind is howling at velocities up to 75 m.p.h. and swinging half-way around the compass, but they are hitting all points on the nose. We are supposed to pass over a pocket-handkerchief size lake and, instead of brushing one edge, we split it right in half.

At this point, a slight accident increases your already deep respect for the jobs these lads are doing. You drop your pencil and by the time you've retrieved it the plane has flown 15 miles. Just five minutes, but we could have been just that far off the course if we had been the navigator on duty. Now we understood why navigators are so busy.

Day turns to a moonless night while we are still in the air, and these lads—one an auto repair man from Kalamazoo, Mich., and the other a store clerk from Chattanooga, Tenn.—swing to their work. Out come sextants and they start shooting their favorite stars. They pick two and shoot each 10 times to strike an average, moving up the "fix" on their position report to keep pace with the speeding plane. Except for slivers of light the instruments flash on the vital reading points, the plane is completely blacked out.

A celestial observation takes about 15 minutes to compute and right on the dot they come up smiling with the note for the pilot.

It takes but little imagination to change this flying classroom to a *Flying Fortress* boring through the night to Tokyo with tons of bombs. Above the roar of the engines you can almost hear the navigators calling:

"Target coming up! Target coming up!"

And then the words of the bombardier, in the nose of the ship, caressing the bombsight:

"Right, right, pilot. Left a bit. Steady there!"

Then the sight of the military targets of Tokyo bursting into flame as the bombardier calls out:

"Bombs gone. Let's go home, navigators."

Hours later we hit Mather Field on the nose, fingers of light stab out of the black void below and we swish to a landing.

We have "blasted Tokyo off the map" and have returned home safely, thanks to the navigators.

END

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Flying at 50,000 Feet

(Continued from page 52)

Figure 6 compares three airfoil sections: the familiar Clark Y, the often-used NACA 23012, and another which is not so familiar—the NACA 43012, which has somewhat more camber, or mean line curvature, than the 23012. The Clark Y has the highest drag at all lift coefficients, so it is definitely out of the picture as far as high-altitude flying is concerned. The NACA 23012 has the lowest minimum drag, but reference to Figure 6 shows that the C_{D_0} vs C_L curve for this section crosses that of the NACA 43012 above a lift coefficient of 0.4, so that at higher values the 43012 is superior dragwise.

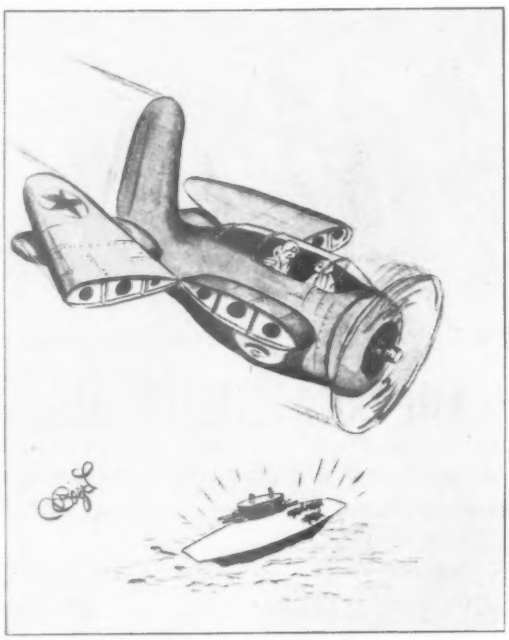
This fact is again illustrated in Figure 7, where it is shown that at sea level the NACA 23012 is superior at all wing loadings, but at 50,000 feet the advantage is all with the NACA 43012, which increases with increasing wing loading. Consequently it would seem desirable to choose the 43012 airfoil, or a section similar to it, for our high-altitude airplane, even though the 23012 would give us superior performance at the lower altitudes.

Figure 8 indicates that if we use the 43012 airfoil for our airplane which is to fly at 200 m.p.h. no matter what wing loading we use at sea level up to 20 lb. per sq. ft., the wing angle of attack is zero or less. However, at 50,000 feet the story is entirely different, so that at 200 m.p.h. even the 10 lb. per sq. ft. wing loading requires an angle of attack of 6°. If instead of 10 we chose 20 lb. per sq. ft. for our wing loading, we would require an angle of attack of nearly 15°, very close to the stalling angle. It is to be noted in passing that Figure 8 shows that if we are able to fly faster, the angle of attack required for the new speed can be reduced considerably.

There are many other high-altitude problems that could be discussed, but it is possible to consider here only a few of the more important ones.

For instance, the propeller offers somewhat of a problem, since it must have sufficient blade area to absorb the engine power in the thin air of 50,000 feet. For our airplane, perhaps, we would need a controllable-pitch, four-blade propeller, with very wide blades. If our propeller diameter is limited because of ground clearance, we may even need five or six blades. We must be careful while choosing a gear ratio, i.e., the ratio of propeller speed to engine speed as determined by the gearing, so that the propeller will not have high tip speed losses because the blade tips are rotating above the speed of sound. The propeller becomes progressively susceptible to these losses because the speed of sound decreases with altitude (with change in air temperature, not pressure).

One of the worst problems to be faced is that of cooling—cooling the engine cylinders or coolant radiator, the engine oil and the engine intake air or fuel-air mixture during supercharging. Since the air pressure is less than one-sixth that at sea level, the pressure drop across the engine cylinders or radiator must be at least six times as great as that at sea level to obtain the same airflow. To attain these high pressure drops we will have to use cowl flaps to induce them, but if the flaps are not sufficient in themselves, then recourse will have to be made to a cooling fan or blower, probably driven off the engine, either ahead or aft of the cylinders or radiator. It should be noted, that although the temperature decreases steadily up to 35,300 feet (see Figure 1), which tends to improve the cylinder or radiator cooling, the decrease in pressure with altitude is sufficient to more than offset this gain. It is then obvious that above the tropopause, cylinder or radiator cooling must become rapidly more severe, since there is no longer any decrease in air temperature. Thus, in actual practice the cooling problem may be more difficult to surmount than all the problems heretofore mentioned.



"Think hard, Cadet Peters. What should you have done before leaving the ship?"

The oil cooling problem is not as difficult and with improved oil cooler regulators, too much trouble should not be experienced. The problem involving the intercooling of the air or fuel mixture between the stages of the supercharger, however, is one to be reckoned with, and is similar to that which concerns the cooling of the liquid, or coolant, of the liquid-cooled engine. That is, a radiator or "intercooler" is required to cool the air or mixture, which has been heated by its compression by the supercharger impeller. Since the greater the temperature difference between the supercharged air and the cooling air the more efficient the intercooler becomes, it would be most efficient, theoretically, to use an "after-cooler" or radiator between the last stage of the supercharger and the engine intake manifold. However, this usually results in poor mixture distribution to the cylinders. Instead of using either one or the other, in our case we might find it well to do *both* intercooling and after-cooling.

Ignition troubles are to be expected at high altitude with air insulated parts, as such difficulties are due to a reduction in air density. Although it would seem desirable to eliminate all air insulation because of this fact, it appears impossible to do so with all electrical devices, particularly the distributor and magneto. If we are to supercharge the cabin and engine air, why not supercharge the electrical equipment needing it? A simple answer is a separate pump, driven by the engine, to do the supercharging.

While on the subject of supercharging, we must not neglect the fuel tank. If the fuel tank and carburetor system are not supercharged, the fuel will boil at high altitude and cause vapor lock and subsequent engine failure. Along with tank supercharging—which requires another pump—we may find it convenient to use a gas such as nitrogen over the fuel in the tank to reduce the explosion hazard.

One other miscellaneous problem that should be mentioned is that of window frosting, which is serious enough with an unsupercharged cabin airplane flying at moderately high altitudes, but becomes much worse with a supercharged cabin at 40,000 to 50,000 feet. This frosting may occur on both the inside and outside of the windshield, although in general, at high altitude, the frosting on the inside is much the worse of the two. As to actual icing of the airplane surfaces at high altitude, little non-military experience has been had, but several long flights up to 34,000 feet have indicated that serious icing conditions above 20,000 feet is extremely unlikely.

Now that you are familiar with all these many and varied problems, of which only some of the more important ones have been discussed here, are you still interested in producing a ship for flight at 50,000 feet? The picture may be very attractive, but the equipment must be made ready first. This will require more research, plenty of determination and hard work.

END

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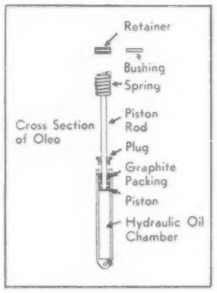
Lubricate Lightplanes

(*Continued from page 48*)

around oiling, and any good hydraulic oil can be used for refilling oleos.

The landing gear takes most of the punishment and should be checked constantly. There are two types of landing gear used on small ships, the oleo type and the coiled shock-cord arrangement. In the oleo type, which has been found to be far superior to the coiled shock - cords, the oil within the cylinder of the oleo takes the greater part of the shock of landing, distributing the stress throughout the unit to greatest advantage. For a safety factor, and to smooth out landings, Aeronca has added a powerful coil spring, either one or the other being sufficient to take the full shock of a normal landing. It is important that this cylinder be full of oil at all times. Evidence of oil scarcity is the tendency of a cylinder to ride low on the piston. The oleo of the Aeronca *Chief* or *Super Chief* holds approximately 14 fluid ounces —that of the *Trainer* and the *Defender Trainer* holds approximately 16 fluid ounces. If the oil in the cylinder is not maintained at a proper level, a great deal of the efficiency of the oleo unit is lost.



To fill an oleo (using Teleo oil or any good hydraulic oil) prop up the front of the ship under the front landing gear fitting on the side you wish to fill. Then remove the connecting bolt at the axle strut and raise the oleo up to a level where you can remove the screw plugs; then pour oil in it until it is completely filled. If it is necessary to change the graphite packing, remove the connecting bolt at the axle strut and oleo, release oleo unit from the oleo case assembly, by removing the bolt at the top of the oleo case. Drive bushing out of spring retaining washer and remove washer and oleo spring. Pry the plug at the top of the cylinder loose and remove old packing. Press new packing into place around the piston rod and replace parts. Extreme care should be taken on replacing the oleo in the case. Be certain that the bolt passes *through the retainer* on the top end of the oleo. If this is not done, the oleo will fall out when the aircraft takes off. This whole operation is seldom necessary but should not be overlooked. If your oleo, for some unknown reason, does not seem to be performing right, observe closely—you will notice that at the front lower end of the oleo case assembly, there is an alemite fitting on each side. Apply grease with a gun, using your own judgment on the amount, at intervals equal to 10 hours of take-offs and landings. Follow this same practice on alemite fittings in the tail wheel bracket and the alemite fitting on the end of the axle of the tail wheel.

Oil all landing gear fittings, fuselage attachings, and streamline strut attachings, after cleaning with vaseline or gasoline. Be careful in oiling around any rubber parts or fittings, inasmuch as oil has a deteriorating effect on them. To insure smooth and free-moving ailerons, whose stiffness is too frequently blamed on the rigging of the ship, remove the outer and center bushings on each aileron, and oil. This should be done approximately every 100 hours. It is advisable to check these bushings and replace them when undue wear is detected. Like the steering wheel in a car, it is necessary to have some play, but too much is more dangerous than not enough.

It is also advisable to pack the ball and socket joint on the aileron (if any) with grease. When oiling hinge joints attaching the rudder to the vertical stabilizer or fin, and hinge joints connecting elevator and horizontal stabilizers, great care should be taken not to over-oil. They are exposed, and excess oil with its tendency to collect dust will increase wear and give the ship an unfavorable appearance. If the front of the cowling and tail assembly surfaces seem to have excess oil on them, have a licensed engine mechanic check crank shaft oil seal and gasket. On some engines, this gasket failing is a common occurrence and should not be overlooked. Do not over-oil, or if you do, wipe off excess with a gasoline-dampened cloth.

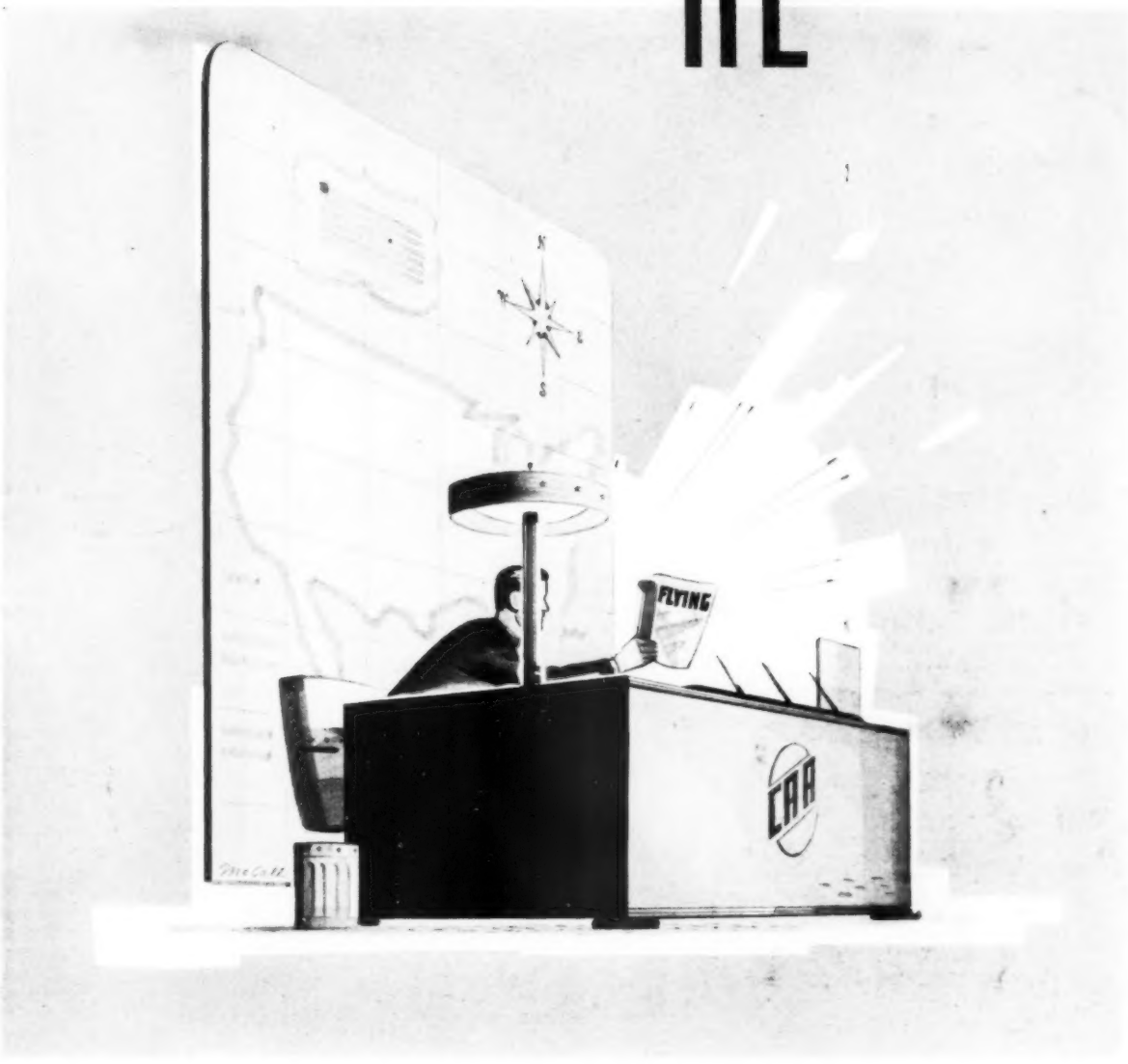
When inspecting or replacing control stick bushings, pack them with cup grease, and oil all moveable parts on stick control, wheel control, rudder and brake pedals. If it is necessary to adjust your seat frequently, it is advisable to place a few drops of oil on the release rods and rails. If your sliding windows have a tendency to stick, try dusting a little graphite powder the full length of the bottom and top channel. A few drops of oil on the door handle shafts, inside and out, will free them considerably and insure their ease in operation. Checking your crank case oil at frequent intervals and draining and replacing with new every 20 to 25 hours is a vital safety factor, not only protecting your own life, but prolonging that of your engine. You can also lessen the necessity of replacing frequently all small moving parts on your carburetor by applying a few drops of oil every now and then.

When replacing a fixed pitch propeller try dropping a little oil on the threads, and in replacing those of variable pitch, a little graphite grease on the shaft will relieve you of many headaches.

To those ship owners who by necessity must dismantle their planes for the duration of the war, we urge that particular attention be given their equipment. Most engine manufacturers are now supplying instructions for the procedures to be followed in placing an engine in storage. With regard to the fuselage, we recommend that all moving surfaces be covered with a light coating of graphite grease to prevent rust and the freezing of movement.

END

WHO MIGHT HE BE?



HE might be Charles I. Stanton, Administrator of Civil Aeronautics. Mr. Stanton, a regular reader of FLYING, is one of sixty-one ranking CAA officials who subscribes to FLYING . . . the most influential and widely quoted journal in aviation.

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(*Continued from page 56*)

ert thunderstorms. So, gentlemen, allow for enough fuel to provide at least a 500 mile range.

Joe has often come back from a few hours of cross-country (in pre-war ships) all worn out, and he's determined that his new airplane must be comfortable. He isn't a softie, but he recognizes flying fatigue as a menace to his safety. He wants a ship that is comfortable in rough air, knowing that air-sickness will be harder to sell his non-pilot friends than the danger of a crash landing.

Joe wants starters, generators, mufflers, built in fire extinguishers, a quiet cabin and good ventilators. He wants a good radio receiver, a direction-finding loop and just enough transmitter to reach the control tower. He wants flares, navigation lights and landing lights. He wants door locks to keep the curious out and foolproof catches to keep the kids in . . . *and he wants all this included in the purchase price just as it is in his automobile.*

He'll need an adjustable pitch prop on each of his two engines. Nothing fancy —just a good "low gear" to lift him out of short, high-altitude fields on hot days, and an economical "cruising pitch" to help him cover ground and cut down on engine wear and fuel consumption. He wants visibility in a measure that you manufacturers have never considered before. By visibility Joe means that he wants to see up, down and all around. He doesn't want to be cooked by the sun in an all-glass cockpit, but he wants a good look at the chump who is trying to do slow rolls around him. He wants to show his passengers the view directly below them, and he wants to be able to look up and back before he starts his takeoff. Incidentally he hopes you'll mark off a floor window as a simple drift indicator. It would help his navigation no end.

Joe will need really fine instruments to tell him where he is and help him get where he's going, and in his simple and forthright fashion he thinks that modern instruments can be improved. He wants an altimeter with a sliding gadget that will tell him how far he is above the terrain, not above sea level. It could be manually operated if it would just take part of the mental load off Joe and not cost too much. Joe would welcome some sort of stall indicator to warn him of slow speed in approach while his mind is on traffic problems. His idea of the perfect compass is one that points where he's going and which is readable without the use of mental arithmetic. Remember, Joe is an amateur pilot and flying has to be simple before he'll go for it.

When it comes to speed, Joe isn't particular. That's going to be a shock to a lot of you manufacturers who have been stretching for high speed above all else in your military and commercial ships, but Joe looks at it this way. First, he recognizes the fact that a reasonable cruising speed will give him a low land-

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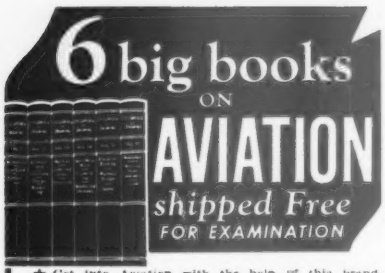

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ing speed—safety again. Second, he figures (and rightly) that 120 m.p.h. in the air is a lot more than twice as fast as 60 m.p.h. in his car, because it's a constant speed. Third, slower speeds are more economical. You don't burn up so much horsepower and gasoline in just overcoming drag.

Surprisingly, too, Joe doesn't want too clean an airplane. It picks up too much speed when he puts the nose down, it requires handling skill that he doesn't have time to maintain and it might get away from him sometime and build up enough speed to rip itself to pieces. No, Joe's demands are not aerodynamically efficient on all points.

Joe will give the engineers room to experiment, however, with his demands for some improvements in the approach department. Like most part-time pilots he has always had trouble getting down in the groove after a long, hard hop. He suddenly finds that he's high and has to slip, or he sees that he's undershooting and pours on the coal (if the engine takes). He's found that flaps are a big help, but they will balloon the ship when first applied, and they will drop the unwary pilot if suddenly taken off. Slips are disconcerting to the passengers and not always safe. And power approaches are frowned on for many reasons. Joe would like to see a spoiler developed which could be controlled from the cockpit. Such a device is used on sailplanes to vary the rate of sink on an approach and is quick and positive in its action.

Joe has a few other odd ideas, too. He would like to see planes equipped with parachutes so that when some Sunday pilot takes off his left wing he can reach for the handle and let his ship and passengers down to a safe landing. He's read articles that prove such a device to be practical and he's just stubborn enough to want something like that on his airplane in spite of the howls of the designers.

That's the airplane that Joe Doakes would like to own after the war is over, and we pilots of tomorrow think that it would suit most of us pretty well.

We know that all you gentlemen of the factories are cognizant of our group. We realize that you face tremendous problems in designing and building our ideal airplane. We know that many things remain to be done to make traffic control, navigation, maintenance and flight instruction simpler for the average pilot. We have no doubt whatever that all these problems will be solved in due time.

This request is a reminder that upon your shoulders will fall the initial task, the job of building the airplane that all of us can buy and fly, easily and safely. After that will come the job that all of us can do, the job of building airports, establishing highways in the clouds, overwhelming insurance companies which place restrictions on private pilots, demanding service stations for our airplanes, advertising flying to the point where it will be accepted as casually as driving. You do your job, we'll do ours.

Yours for Victory first, and then *Wings for the Family.*

END

Working Girl

(Continued from page 42)

flyers and non-flyers, followed. The overflow wangled space for the long tables and silky 'chutes in the audition room of a local broadcasting station.

When Joe Crane, licensed rigger at Roosevelt Field, ended his 60-hour courses with a rigid examination, 25 members of the Women Flyers of America qualified for the certificate he gave them.

When the girls hand in their $5 membership fee to the head office they are given free job tips through the member-edited bulletin—if there are any jobs. They are also informed that it is their $5—plus a dinner-dance or two in New York—which pays all administrative expenses.

If a group of enthusiasts clamor to form a chapter they are firmly reminded that good faith means a minimum membership of 15 before they can be granted a charter, plus enrollment at ground school, as well as flying lessons. But once the machinery for a chapter is in motion (or where isolated girls join up with a group not yet big enough to call itself a chapter) headquarters writes to the nearest Government approved airfields. Then the board sits back to wait for news about a rebate. In nine cases out of 10 it comes, because the Women Flyers guarantees to furnish a group of at least 10 would-be flyers at a time. And they keep on—usually indefinitely. The airfields know that.

With the backing of the Women Flyers the girls can thus sally forth with money for their first lesson in their pockets. (Before their membership is accepted they have to pass their medical examination). Then they start saving nickels and dimes for the next, and so on *ad infinitum.*

Planes can be rented, usually at a discount, with the help of the national organization. They can even be bought by more plutocratic members, in the same way. In 1941, with the first flush of interest in defense activities, motor repair classes vied with elementary and advanced ground school courses. Last autumn Washington followed New York's Metropolitan Chapter in setting up its own parachute rigging class.

Albany and Utica, N. Y., Lincoln, Neb., Cleveland, O., and Chicago, Ill., Philadelphia, Pa., and Washington, Boston and Hartford, Conn., these were the early chapters. Others like San Francisco, are in process of forming after the war is over, the organization will have its own flying field . . . exclusively for women . . . where girls will be trained.

As to war jobs, Managing Director Vita Roth, for one, is flatly outspoken against war as women's game, though she runs to and fro to Washington, seeking out defense authorities with an eye for openings to satisfy seething ambitions of her fellow-flying members.

"We don't ever expect to be in combat; that's a job for men," she says. "It's all 'bunk' to say women are better pilots than men. We aren't. Most women don't

have the mechanical talent or physical stamina of average men pilots; but we are qualified for secondary service behind the lines!"

The occasion was the hullabaloo after Jackie Cochran flew a bomber to England and Mrs. Roth combined business with pleasure and organized a Miami chapter while she vacationed in Florida.

That same Miami chapter is a good cross-section answer to the question, "Who are these 'Women Flyers of America'?"

Despite the luxurious atmosphere of "Happy Landings," their tropical clubhouse full of aerial trophies gathered by flyer Annette Gipson, most of the Florida members are working girls.

Clarissa Ellis is a dancer, with an Army family background. She's already a pilot who's going to use her knowledge for fun and transportation. Dorothe Ashe is the daughter of the president of the University of Miami, and says she'd hate to teach school but wouldn't mind teaching flying. Vivian Lerner is a magazine artist who hopes by the time her training is over there will be a field for women transport pilots. Sue Clark's a stenographer who's interested in stunt flying and is working for her commercial license now. Jean Small, junior at the University of Miami, says she thinks it's "just a good thing to know."

Then there are those other girls whom the beginners envy—Helen Lucille Boudreau of Douglas Manor, L. I., with over 1,000 hours logged; and Margaret L. Cox of Birmingham, Ala., claim supervisor of the Social Security Board, who's found time to accumulate 350 hours, and Willa B. Brown of Chicago who's director of an approved flight school, and Mabel Sherman Johnston out in Tulsa as a commercial pilot—and a score of others. Some of them flew professionally or privately long before they joined the "Flyers"; the "old timers" joined up because they want to encourage any good organization that will interest more women in aviation.

But the bulk of the membership are girls whom "Wiggy", chief pilot at the Embry-Riddle seaplane base in Florida describes as "the tomboy type who make the best flyers." They are the ones who are clamoring for a part in the defense program.

But if you've been a working girl all your adult years and you've wanted to fly and finally found a way to make your money go 'round, and you've once tasted the exquisite sensation of taking a plane up and setting it down—you won't need any incentive from the Government. You'll join the Women Flyers of America and be on your way up.

END

Awarded Gough Trophy

GILL ROBB WILSON, president of the National Aeronautic Association, has been awarded the William J. Gough memorial trophy. Mr. Wilson was chosen by Air Service Post 501, American Legion, as the individual whose achievements in aviation were most outstanding for the year.

How to get into Aviation—Now

by C. S. (Casey) Jones

Facts about the opportunities and training now available to those who wish to enter aviation.

What can I do to get into aviation? How can I become a pilot—navigator—bombardier—inspector—aircraft mechanic or engineer? What courses are available and what are the requirements?

C. S. JONES

Questions like these are constantly submitted to my associates and me. This is because our schools have long been engaged in training young men in the mechanical and technical phases of aviation. And, while our two schools are operating at capacity and primarily for the United States Army, we want to be helpful to any and all who seek an aviation career.

• • • •

Many thousands of ambitious and patriotic Americans are eager to get into aviation now. The government, the airlines and the aircraft industry are conducting training courses, in various phases of aviation, to prepare men and women for an early and active part in this industry which is so vital to the country's survival today, and which holds so much promise for the future.

There is a need for spreading information on this subject. Our schools have decided, therefore, to take space in a number of magazines—of which this is one—to answer questions and report facts on job and training opportunities which are now available in aviation. In so doing, we hope to render a service to the public, the aircraft industry and the air forces.

• • • •

Readers are cordially invited to submit questions, which will be answered in this column if of general interest.

• • • •

The next column to appear will contain information on the Airlines Training Program.

C. S. Jones
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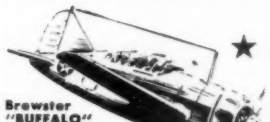

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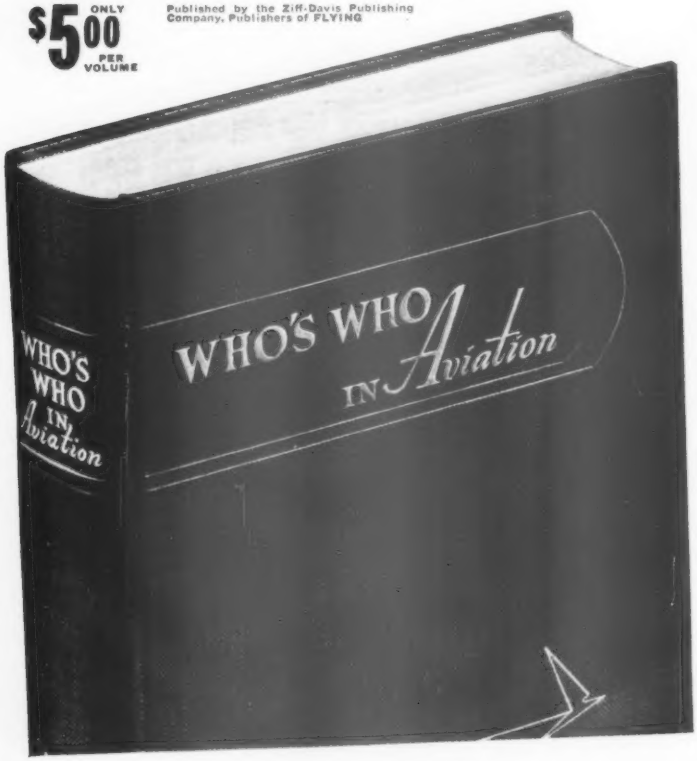

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Sailplane Seminary

(*Continued from page 24*)

with the characteristics of the high performance sailplane. The span is 52 feet; aspect ratio 12.6; weight, empty, 450 pounds; wing area 214 square feet; gliding ratio 23 to 1.

The TG-2 is the glider in which the unofficial world record of 14,960 feet altitude for glider, with passenger, was established at Sun Valley, Ida., in 1940.

Instruction begins at dawn or soon afterward. During early mornings the launching airplanes are kept busy. Flights are short, due to lack of thermal conditions. During the late morning and afternoon, however, the desert warms and flights lengthen as the rising thermals provide lift. Then more gliders may be kept in the air using the same amount of planes for launchings.

Training operations at Twenty-Nine Palms involve flights of various distances and duration. Because of the present lack of sufficient equipment for the large number of students enrolled, long flights are discouraged. Altitudes of 5,000 to 6,000 feet frequently are attained by advanced students, but altitude flying also is discouraged because of the time it consumes. Also "street flying," flying from one thermal to another under a long chain of clouds to gain distance, and "thunder-cloud flying," soaring upward in a cumulus cloud for altitude, are not encouraged.

In the mornings the students test their skill of gliding, turning and landing. As the day progresses, and the wind blows against the face of the mountain ridges, the students slope-soar (as did Thompson) supported in the air by the deflected upward current, where they cruise within the updraft. Still later they do a little "thermal" soaring, riding on the warm currents which rise as bubbles of sunheated air from the desert and spiral upward through the heavier and cooler air above.

Part of the day's training is devoted to formation flying. V-formation in a double or triple tow train in rapid flight requires split-second thinking. The gliders take off simultaneously an instant before the towplane. The students fly high enough to avoid the airplane's slipstream, else their gliders would bounce around like kites in a maelstrom. They do not fly too high lest they pull up the towplane's tail. In flight they hold their positions with precision, otherwise the tow cables might tangle and cause the whole train to crash. Hook-and-ladder "rudderman" turns are practiced again and again.

Skull practice takes place in up-to-date classrooms. The cadets learn such subjects as the history of gliding; glider types; glider construction; formation flying and meteorology. They know their "stuff" and can joke about it too, as witness the blackboard 10 minutes after class is dismissed. Two men in a fighting pose, labeled *spar;* an empty clothesline, and one full, mostly of feminine things, captioned *wash in, wash out.*

Enlisted students do not salute their civilian instructors but address them as "sir." The instructors are the best obtainable. John Robinson, one of the four American holders of the international Golden "C" soaring certificates, the highest type of soaring recognition granted, is a senior instructor. For the past two years Mr. Robinson has been holder of the United States soaring championship, awarded on the basis of performance at the national glider meets at Elmira, N. Y.

Life at the academy is not all work and no play. Men lounge in their rooms, which are equipped with lockers and desks for writing. They swim or play ping pong, pool and billiards in the recreation room. In town they go to movies or dances. Yes, a cadet is treated royally and if he should fail in his course he can work up through ranks or attend an officer's training school.

Officers and enlisted men train in grade and upon successful completion of the prescribed course at the academy, enlisted men will be promoted to the grade of staff sergeant and all successful graduates will be rated glider pilots. If the student trainee holds one of the first three enlisted grades, he will maintain such grade upon graduation and be rated glider pilot. But grade and title are subject to change in the pilot's favor. Lucky is the man who can get in and stay in our glider program—and attend the Army's Twenty-Nine Palms Air Academy.

The cadets who will graduate soon from this glider school will form one of the first large constituents of Army glider pilots. And these pilots, who earned their wings in the golden glider-sailplanes, will make a new kind of history in our armed forces.

END

The Trusty 'OX'

(*Continued from page 72*)

mobile. It's a dirty job, it's unglamorous —but it's a lot of fun!

Indeed, OX-ing is a sport far removed from the macadam runways and the uniformed attendants and the control tower airports of today. OX-ers are the modern counterpart of the vanishing American.

They tell a favorite story around Philadelphia airports. Two college boys—CPT students — were standing around waiting for their turn on a lightplane. They were watching two OX-ers check the overheads and drain the wells on their OX. The OX-ers in greasy and sloppy overalls were talking shop, as it were, and one was telling the other of a horsepower improvement with double ignition. Getting just drifts of the conversation, the college boys were puzzled. Finally one of them turned to the other and asked, "Why do they rate the power of an *ox* in the terms of *horse?*" The other replied, "I understand that in the old days, they used to rate all motors in terms of OXpower."

See what I mean?

END

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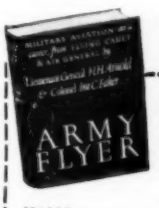

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See Announcement On Page 146

Propellers

(Continued from page 60)

placed by a controllable-pitch propeller, it is possible to use a more satisfactory propeller diameter. The noted increase in thrust horsepower available is the result.

From the foregoing, it is at once apparent that the performance, especially take-off and climb, of all airplanes, will be improved if a controllable-pitch or constant-speed propeller is used. However, it is also noted that the greater the difference between top speed, and take-off and landing speed, the greater will be the benefit of such an improvement. This indicates that the high-performance airplane will enjoy the greatest benefit from the use of a controllable propeller. It may further be assumed that as the performance increases, a point will eventually be reached where the desirability of using such an arrangement becomes a necessity because as the speed range increases, it becomes more and more difficult to get sufficient thrust horsepower for take-off from a fixed-pitch propeller. This is especially true in the case of the lightplane, since the ratio of power available and power required is much smaller than the higher-powered airplanes.

In the foregoing it has been assumed that a normally aspirated or unsupercharged engine has been used (the popular lightplane engines are of this type). It is well known that the horsepower of an internal combustion engine decreases as altitude increases. This decrease in power is due largely to a decrease in air density. Propeller thrust and torque forces also reduce as altitude increases. The reduction in propeller horsepower is approximately the same as the reduction of engine horsepower of an unsupercharged engine. Thus, if a fixed-pitch propeller, designed for sea level performance is installed on an unsupercharged engine, the design is quite satisfactory for altitude performance. However, if a fixed-pitch propeller designed for sea level performance is installed on a supercharged engine, it is obvious that as altitude increases the propeller would race because of the decreased thrust horsepower absorbed. Further, if a propeller designed to hold the supercharged engine at altitude is used, take-off performance at sea level would be adversely affected. It is therefore quite apparent that the engine designer is free to make use of supercharging as a method of increasing power if a controllable propeller is made available for the lightplane,

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whereas, without a controllable-pitch or automatic, constant-speed propeller, supercharging is of little value.

In addition to the performance during take-off and flight, the propeller plays an important role during the landing operations. In the case of high performance aircraft where a high-pitch propeller is required, floating during landing is augmented because of the relatively high thrust from the propeller with the engine idling, thus tending to lengthen the approach. The landing run is also proportionately increased. This condition is entirely remedied by the use of a controllable-pitch propeller. In fact, the propeller's pitch may be reduced sufficiently to use it as a brake. This practice, however, should be used with great judgment. There are on record instances where accidents were caused as the result of the pitch being reduced excessively, and when the pilot "gunned" the engine to stretch his glide, forgetting he had reduced the pitch.

The development of low powered multi-engined aircraft, especially the two engined type, has been definitely retarded because of the lack of a suitable controllable propeller. With this type airplane, all of the performance requirements of the single-engined airplane must be executed with one engine inoperative. It is a difficult problem to design a twin-engined airplane with a satisfactory single engine performance of any horsepower. The present high performance transport and service airplanes of this type would be impossible without the benefits of the modern controllable-pitch propeller. The problem of single-engine performance of the light twin-engined airplane is more difficult than that of the higher-powered craft because the adverse effect on the ratio of power available to power required in the case of the low powered craft. For installation on a twin-engined aircraft, the maximum benefit is realized if the controllable propeller is of the full-feathering type.

The controllable-pitch or constant speed propeller opens the door to advances in airplane and engine design which are definitely closed if only a fixed-pitch propeller is available. Furthermore, the ultimate gain in performance from such an arrangement will come only when the airplane and engine are designed to take advantage of its possibilities.

END

"One If by Land . . ."

KEEPING an eye open for ranchmen and cowboys in trouble is a sideline of TWA pilots in the west. The standard distress signal is three separate fires. Pilots sighting such beacons radio in the location, so that rescue parties may be sent out.

Brazilians Take to Air

A CHAIN of 326 Brazilian flying clubs has been organized in the last 18 months as the result of a campaign conducted by a chain of newspapers. More than 200 planes have been donated to the clubs by newspaper readers.

Hirohito's Palace

(*Continued from page 29*)

landslides, volcanic eruptions, great conflagrations and epidemics. Such were natural events. Air raids are not in the Japanese book of experiences-to-be-expected, although air raid drills have been conducted since 1934.

The first raid, on Formosa—Japan's Gibraltar of the Pacific, the springboard for her Philippine attacks and, earlier, the debarkation point for Hainan and Indo-China—caused severe damage to a field near Taihoku, the capital, in 1937. Chinese, and it is believed some Soviet pilots, did the trick. Though nearly 2,000 miles distant, Tokyo ordered a blackout for two nights following that attack.

Chinese appeared over western Japan in 1938, to drop pamphlets instead of bombs. The psychology of the pamphleteering was poor for it advised the Japanese farmer peasants to "overthrow the imperial shackles." Workers who fear the Jap police and revere their god-emperor, instead of carrying through the Chinese hint, picked up the handbills and carried them to nearby police stations.

A year ago I began a research job for FLYING on a pattern of air attack on Tokyo. The result, in 5,000 words, was published in FLYING last December, under the title "Stop Japan Now," the theme being to "give her Hobson's choice, otherwise drop our compromise policy and face the dilemma with firmness and force."

General Doolittle's official report had paragraphs which parallel my study of such an attack, such as: "Amazingly little opposition was encountered. A few pursuit ships arose but the pilots seemed inexperienced. These were completely ineffective. Several, we know, were shot down."

My last year's story reads: "Tokyo is a military aviation officer's dream of pandemonium. . . . The percentage of pilots who could be considered first class is extremely small. The younger conscripts are extremely inefficient."

General Doolittle remarked in Washington that there was little difficulty in finding the assigned targets. My article stated "a flight of bombers will find, in one glance, three vehicular bridges and approaches of the mile-wide Shinagawa river south of Tokyo. Tokyo's suburbs have mushroomed thousands of armament factory smokestacks."

"The target for one plane was a portion of the navy yard south of Tokyo, in reaching which it passed over what apparently was a flying school," reported General Doolittle.

I wrote that "important naval bases will be vulnerable to bombardment. Antiaircraft defense cannot function until the attacking force is over their objectives. Such airports as Japan has could be bombed completely out of commission as they have such few bases and cannot move freely to newer fields due to the condition of the terrain."

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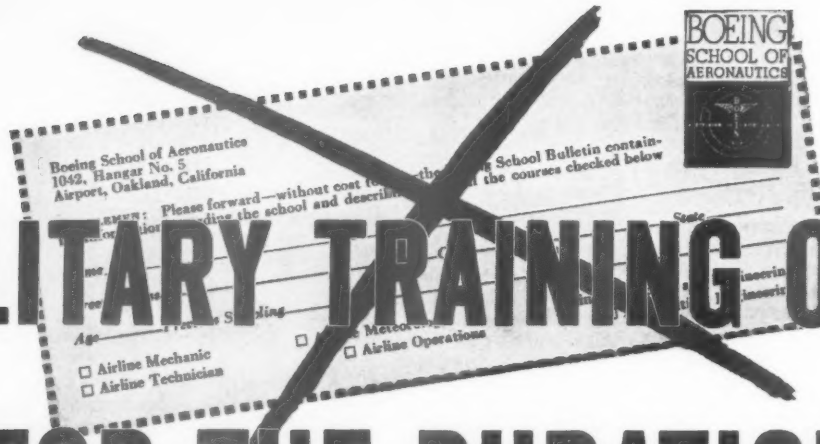

MILITARY TRAINING ONLY FOR THE DURATION

The Boeing School of Aeronautics, a division of the United Air Lines, has converted its facilities entirely to military training purposes, and has suspended commercial instruction for the duration

In the first presentation of its kind ever made, the United States Army Air Force Technical Training Command recently awarded the merit pennant illustrated here to the Boeing School of Aeronautics for "outstanding service" in schooling Army Air Force mechanics and technicians during the past two years. This pennant, comparable to the Navy's famous "E" flag, will remain in the possession of Boeing School for six months and will then be re-awarded to the technical training school performing the most meritorious service during the last half of 1942.

THIRTEEN years ago, on September 16, the Boeing School of Aeronautics was established at Oakland, California, Municipal Airport, primarily for the training of students desiring flight or ground careers with air transport companies.

During these years the familiar coupon in the advertisements for Boeing School of Aeronautics claimed the attention of many ambitious young men. Those who enrolled and completed their courses have proved that "Boeing Grads make good." All over the world—in more than 100 companies—these trained men have been advanced to positions of responsibility as pilots, engineers, technicians, meteorologists, and mechanics in aircraft factories and every department of airline operation. Already, in the armed forces, Boeing Grads are demonstrating the quality of Boeing training by outstanding performance.

Today Boeing School of Aeronautics is "all out" for war for the duration. The program involves the expansion of the army mechanical training, as well as the addition of flight crew training. When the war is over, Boeing School will be qualified more than ever before to contribute its facilities and training for peacetime activities in aviation.

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"One salvo," General Doolittle narrated, "made a direct hit on a new cruiser or battleship."

I made a flat statement that "all shipbuilding industries are located in the main ports; Japanese naval bases and shipyards are extremely vulnerable because of the lack of antiaircraft defenses."

Evidently the visiting American bombardiers found just such a deficiency in Japan's greatest base—Yokosuka—where this attack occurred.

One American flyer bombed a quarter mile of an aircraft factory at Nagoya. This is the one I singled out as "the largest, which is the Mitsubishi Aircraft Works, producing pursuit and bombardment airplanes, engines, propellers and aircraft accessories." Its quarter mile length was set afire by American incendiaries.

Japan cannot have effective air defenses because it will be practically impossible to organize sufficient antiaircraft defense on boats to strike at enemy craft before they arrive at their objective.

I disagree with General Doolittle on one point—that the Americans did not bomb the imperial palace in Tokyo, although bombs were dropped near that sacred place—because it was not a military target.

One month after the Tokyo bombing, a great and famous Japanese ship, the *Nagasaki Maru*, hit a mine in Nagasaki harbor and was destroyed. The captain, a veteran in the Japanese marine service, shot himself in the offices of the N.Y.K. line. Three months after Pearl Harbor, a well known Jap diplomat, Satomatsu Kato, "fell" from a window in his Paris embassy and was killed.

To bomb the imperial palace on the next trip will hasten an end of the war and, by being forced into fanatical suicide now, many of Tokyo's leaders will speed the day of an Axis hanging.

END

Minimizing Air Injuries

(*Continued from page 24*)

cial forms for accident injury reports, including anatomical charts for the use of physicians, were distributed and the co-operation of all doctors and surgeons was sought.

Now, when an accident occurs, in addition to the usual routine information which the investigators have to report to Washington, they will be required to ascertain such data as the direction in which the victims were thrown by the impact, the attitudes in which they came to rest, the structural member or members of the plane which caused the injuries, the condition of the seat and seat belt used by the victim and the damage to the cabin or cockpit adjacent to the seat occupied by the victim.

Doctors, although already heavily burdened by the necessity of making lengthy and detailed reports to all sorts of agencies, are being urged by the National Research Council to complete the special medical form provided for use in connection with airplane accidents and to indicate the nature, location and extent of injuries on the anatomical chart as graphically as possible in red ink. To shade the location of tender areas, bruises, burns, etc., giving dimensions of contusions and lacerations; direction and displacement of fractures, dislocations, etc., and to indicate the order of importance of injuries.

From such data it should be possible to learn whether substantial numbers of the same type of injury are being caused by the same part of a plane; for instance, whether numerous victims occupying Seat 4 in a standard passenger plane are having their skulls fractured by a projecting ventilator. If so, there's little doubt that later models of the plane will be minus that projection.

A graphic illustration of the potentialities of this study was furnished by an accident which occurred in Oklahoma several years ago.

An airplane crashed and began to burn. One of the passengers was trapped in his seat for a time but was rescued and was able to tell why he had been unable to free himself. It developed that his safety belt buckle was located down at one side of the seat. That would have made little difference had it not been for the fact that his arm on that side was broken by the impact and he could not reach the buckle with the uninjured member.

It was not long after that that all seat safety belt buckles were required to be located so that they are directly in front of the passenger when fastened and can be unfastened by either hand.

In a message to physicians and medical officers in charge of persons injured in air accidents, the CAB's Safety Bureau said that a marked improvement may be made in the safety of aircraft by altering the construction of objects presently responsible for injury in minor and moderate accidents and pointed out that a considerable number of survivals without serious injury had occurred in some very serious accidents.

It is not possible, of course, to list all the improvements which may be made as a result of the "protective research" undertaken by the Board and the National Research Council. However, the automobile industry already has pointed the way with its elimination of all projecting knobs, buttons and sharp surfaces from automobile instrument boards and projecting doorhandles and window lifts. Aircraft builders might well follow suit.

Some authorities have suggested that if aircraft passengers sat with their backs to the pilot, they would have the support of their seat backs in the event of a crash stop in landing. This device may easily be adopted in the transportation of military personnel, because soldiers will sit where and how they are told. With civilian passengers, it's different. A great many of them don't like to travel backwards in any sort of conveyance, be it plane, train or ox-cart.

These same little personal idiosyncrasies crop up when any suggestion is made with reference to protective clothing for the traveling public. Undoubt-

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edly, if train, bus or plane passengers would wear a combination of football harness, helmet and a baseball mask, they would be in much less danger of serious injury in the event of an accident. But imagine the outcry if well-dressed women and harried business men were required to climb into a rig like that for safety!

The alternative, then, seems to be to put the padding on the trains or planes, on the surfaces which might cause injuries, and to remove the projections which might prove dangerous. When the data have been analyzed and given to the industry, lack of organized knowledge of the injury potentialities of aircraft should no longer contribute to pilot and passenger fatalities.

END

Teeth

(*Continued from page 54*)

open—if it is closed for *any* reason—the high altitude pressure inside the ear will still prevail while the pressure outside increases proportionally with the number of feet of the descent. Since the inner ear gives the pilot a sense of balance according to the pressure, that sense of balance may be affected to the extent that the pilot suffers extreme dizziness or entire loss of consciousness.

It was found on investigation that many causes of eardrum rupture had been reported during diving tactics. Dr. Willhelmy found numerous cases where the pilot, instead of pulling out of his dive had started the ship spinning, and crashed. This had previously been explained by assuming that the controls jammed or some other mechanical part of the plane had proved defective.

One of the country's most famous test pilots, in an article published after his death, made this statement: "I have *that* kind of ears which will not adjust themselves to changes in atmospheric pressure."

If this pilot had *that* kind of ears, Willhelmy observes, they were caused by a faulty bite—teeth which did not fit.

Every pilot is familiar with the strict Army and Navy regulations regarding health in general and teeth in particular. But few realize that if they have *that* kind of ears they are caused from *that* kind of teeth, and in nine out of 10 cases the tensor muscles are closing the Eustachian tubes, preventing air from reaching the inner ear.

Dr. Willhelmy does not know what per cent of pilots have teeth that do not fit evenly. A great deal of constructive work is being done at the Aero Medical Laboratory, Wright Field, Dayton, O. Members of the dental profession all over the country are interesting themselves more and more in some phase of this work, but most of their research has been devoted to the subject of mouth infection and decay and the effects these may have on the reactions of the pilot.

"The number of men rejected by the selective board for dental deficiencies," Dr. Willhelmy said, "has been appalling. In a recent survey of some 200 pilots whose mouths were X-rayed as a part of a complete physical examination, 92 per cent were found to be in need of some type of dental treatment. Only three per cent of these men were actually under treatment at the time of the examination.

"The results of this survey prove that pilots' mouths are no better than the average run of the general public. All of the common faults were found—abscessed teeth, cavities, cysts, impacted teeth, pyorrhea, missing teeth, etc."

According to Dr. Willhelmy a great deal of research is now being done by the dental profession on the subject of mouth infection and decay. Mouth infection is known to be of three types; a disease of the gums, root abscesses and infections arising from inferior quality dentistry. Some of the results of mouth infection are heart lesions (a morbid change in the structure) and a general rundown condition of the whole body.

The effects of general decay are not so well known. Much work is being done on this, and it is the hope of Dr. Willhelmy that soon some valuable announcements can be made which will reveal a great deal more about the results of tooth decay. It cannot be said definitely whether or not a condition of decay has any effect on the sense of balance.

Of course it has long been known that a sense of balance is not reliable in the air, and that a sudden loss of altitude is apt to cause extreme dizziness, but Dr. Willhelmy was the first to point out the relationship between the "overbite," the Eustachian tubes and this loss of the sense of balance.

The Army and Navy have recognized the worth of Dr. Willhelmy's discovery, and a rigid examination of the teeth for the correct bite is a determining factor for all U. S. pilots today.

END

Airline Pilot

(*Continued from page 28*)

sengers and equipment to a new captain. No, he is not just sent to the free air to shift for himself. He is carefully watched (though he may not be aware of it) by fatherly chief pilots who hover over his first weeks of captaincy, alert for any harmful tendency that he might inadvertently be developing.

The opportunities of the man learning to fly today are probably greater than ever before. But, the newcomer must not feel that all he has to do is amass 1,000 hours or so and thus become eligible for an airline co-pilot's berth. As a matter of fact, the prospective co-pilot must school himself through those hours as carefully and with the same methodical study as does the budding young doctor or architect. He must be supercharged with the will to learn, the eagerness to learn and, most of all, the *ability* to learn. He must submit himself to supervised training under his captain for an indefinite period before he can even hope for promotion.

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volved and his family. To arise to such heights, however, requires years of educational investment. Many boys fail in their probationary period (with most airlines usually a year) because they lack any appreciation for the future and throw everything they have learned to the winds, through a mistaken feeling that their value to the airline became unlimited from the day of employment.

Five years hence a co-pilot's position will be one of the rarest things on the market. If not in five years, then at least when the war is over. The rate at which multi-engined pilots are being trained is almost unbelievable. And when the war ends there will be an exodus of pilots to the air transport companies. In turn, the co-pilot and captain will be occupying the most competitive positions in the airline industry. As they must be today, the two men in the cockpit of an airliner must stand head and shoulders above the rest of the field if they are to remain in command of an airplane that carries the most precious cargo of any ship—the human life.

END

Ice Indicator

(*Continued from page 42*)

Larson turned to the Minneapolis-Honeywell Company which, before the war, was making all sorts of gauges to register and control both heat and cold. They put Kliever to work. His first indicator covered a six-foot table with a litter of wire. But he and his assistant, Richard Franzell, cut the thing down to this compact five-pound indicator. Then came the test. That took a little more inventing. It was warm weather in Minneapolis, but it was cold enough at 20,000 feet up, so Kliever set his indicator into a section of a plane wing which he secured to the side of a plane.

Then he connected a water tank inside the plane, with a tire pump fixed so that, at 20,000 feet, he could spray this wing section. In this way he created a make-believe November.

The plane got up to 9,000 feet. Kliever was hanging out the plane door, pumping. Suddenly the indicator's dial swung just as ice began to coat the wing. The gadget worked. It worked on several such flights. Then it was installed on a plane that flew out of Minneapolis all last winter. Now the company has it in production.

END

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Grasshopper

(*Continued from page 68*)

bombers for the Army Air Forces. Twenty-six is the top age for an AAF aviation cadet but they may be a decade older in the "grasshopper" force. An aviation cadet has to have flawless eyesight, but CAA-trained pilots have a margin up to 20-50, if their vision is correctible with the aid of suitable glasses to 20-20.

Until the CAA started in September to supply weekly groups of candidates, the "grasshopper" force relied for recruits largely on men already in the Army. Now the CAA has in full swing its program of giving primary training to men who will become service and glider pilots and airline co-pilots, as well as pilots of what are officially designated as liaison planes.

The field artillery turned to lightplanes after their value as substitutes for observation balloons had been demonstrated in the British and Russian armies. Only a little more than a year old, the "grasshopper" force set an impressive record in its formative period.

An original group which numbered 33 officers and men at the outset flew a total of 850 hours in training last year without accident, an additional 850 hours at Forts Sam Houston and Temple in Texas, and 500 hours at Fort Bragg, N. C., with only a single accident in which, incidentally, nobody was hurt.

END

Letters

Sons

Sirs:

Would it be possible to obtain a copy of a photo of my son, Corp. R. G. Locke, which appears on page 123 in the Special Royal Air Force Issue of FLYING? The picture is captioned "These are the Tail-end Charlies, RAF air gunners, doing a bit of homework on practice targets at their base." The picture, in color, shows my son holding a belt of ammunition on the right side of the chap firing the gun . . .

That picture must have been taken when he was in Bombing and Gunnery School. My son, by the way, is a flight engineer. So if you can send us a copy of that picture, we will be very grateful.

My husband and I have bought several copies of this issue for friends and we all think it just the grandest aviation magazine published, and of course this special issue the very best.

MRS. T. W. LOCKE
Winnipeg, Manitoba, Can.

Sirs:

In your September issue of FLYING you publish a colored photograph headed "Invaders."

We are almost convinced that the boy

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on the extreme right holding the green bag is that of our son, Sgt. E. B. Egan, R92046, RCAF, attached to the RAF. The reason of our special interest is that on August 7 we were notified by the Air Commodore of the RAF that our boy was reported missing from operational flight on July 31st.

J. C. EGAN

Vancouver, B. C., Can.

● Pictures in the RAF issue were made from transparencies, the originals of which were returned to the RAF after the issue went to press. On checking with RAF officials, we learned that Sergeant Egan was not in our picture.—Ed.

END

At Deadline

(*Continued from page 8*)

fillet in the drawing is checked for accuracy. In the case of our own aircraft, the results have been as gratifying as are the highly developed silhouettes of *Flight* and *The Aeroplane* in England.

With enemy aircraft—the types that should be most accurate of all—it is a much different situation. Nearly all information on enemy aircraft in the files of U. S. Army and Navy intelligence divisions are classified as military secrets. Hence little or no detailed information is available to us for silhouette work. In Britain, however, the situation is almost exactly reversed. Accurate and detailed silhouettes, cutaway drawings and specification tables on enemy aircraft are available within a few weeks—in some cases a few days—after the information has come to the Air Ministry.

In addition, such information and material is supplied on friendly aircraft as well—one reason, probably, why British aviation publications are able to publish the most technical details on American types before we in this country are permitted to say more than that such an airplane exists. For instance, an aircraft identification booklet arrived in our office this morning from England, dated September, 1942, in London. In it are complete and detailed specifications, performance figures and designations for such current U. S. military and Naval aircraft as the B-17F, the Brewster SB2A-2 *(Buccaneer)*, Consolidated PB2Y-3 *(Coronado)*, B-24D, Curtiss P-40F, Douglas A-26 (a new version of the A-20C), Lockheed A-29 *(Hudson III)*, P-38D, B-34 *(Ventura)*, Martin A-30 *(Baltimore)*, B-26B, North American B-25B, P-51 *(Mustang)*, Republic P-47 and the Vultee A-31 *(Vengeance)*. As this is written, none of these have been described in anywhere near such detail in the American press.

* * *

OUR special issues really started something around these offices. Radio News, our sister magazine, has just gotten out a U.S. Army Signal Corps issue that has us reeling. We've no alternative but to try to do them one better—and plans are completed.

* * *

Gangway!

END

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